FINAL
CORRECTIVE ACTION PLAN
FOR SITES 2 AND 10
AT
119th FIGHTER-INTERCEPTOR GROUP
NORTH DAKOTA AIR NATIONAL GUARD BASE
HECTOR INTERNATIONAL AIRPORT
FARGO, NORTH DAKOTA

JUNE 1994

Prepared for

Air National Guard Readiness Center
Andrews Air Force Base,
Maryland 20331-6008

Submitted by

Hazardous Waste Remedial Actions Program
Oak Ridge, Tennessee 37831
Managed by
Martin Marietta Energy Systems, Inc.
for the U.S. Department of Energy

Prepared by

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This report details plans for corrective actions needed on contaminated soils at sites 2 and 10 at The North Dakota Air National Guard Base in Fargo, North Dakota

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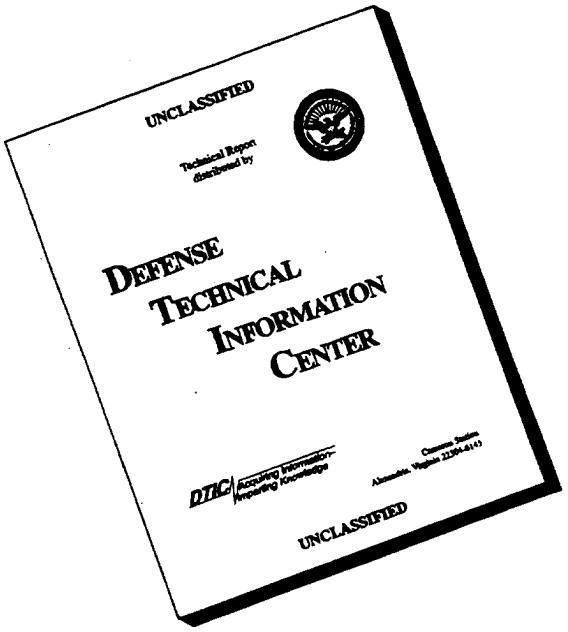

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Haley Wihongi
ANGRC/CEVR

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LIST OF ACRONYMS

ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
BGS	below ground surface
BTEX	the sum of benzene, toluene, ethylbenzene, and xylenes
CAP	Corrective Action Plan
DOE	Department of Energy
ES	Engineering-Science, Inc.
HAZWRAP	Hazardous Waste Remedial Actions Program
NDANG	North Dakota Air National Guard
NDSDH&CL	North Dakota State Department of Health and Consolidated Laboratories
PEER	PEER Consultants, P.C.
SI	Site Investigation
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
UST	underground storage tank

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1.0 INTRODUCTION

1.1 BACKGROUND

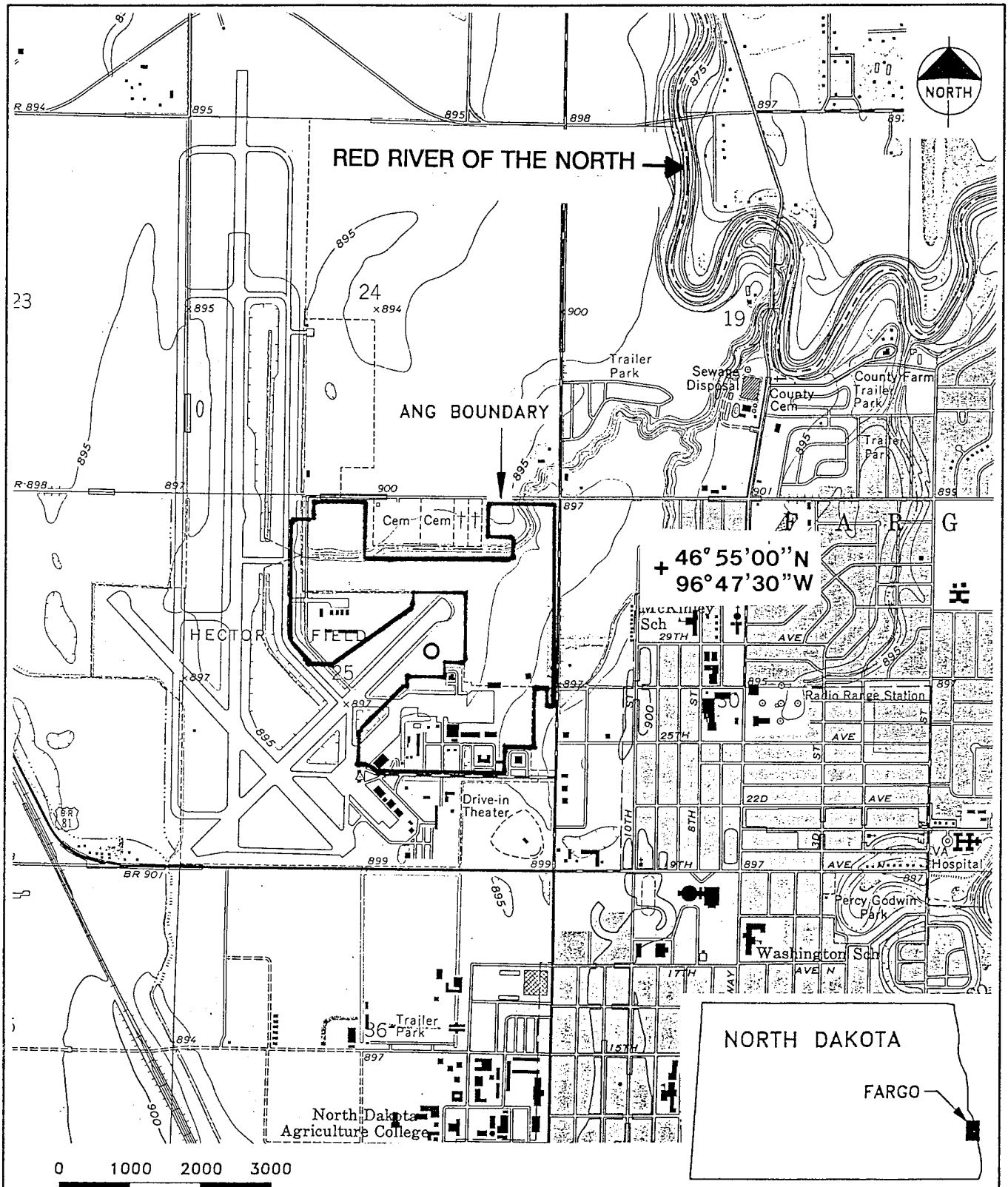
This report details plans for corrective actions to be conducted on contaminated soils at two sites at the North Dakota Air National Guard (NDANG) Base, Hector International Airport (also known as Hector Field), Fargo, North Dakota (Figure 1.1). The sites include one 300-gal nominal capacity waste oil underground storage tank (UST) which is scheduled to be removed (Site 2), and a former fire training area (Site 10) where treatment of contaminated soils is scheduled. The objectives of this Corrective Action Plan (CAP) are to provide corrective action alternatives and to recommend the most feasible option.

The Air National Guard Readiness Center (ANGRC) provides support to Air National Guard (ANG) facilities to conduct UST closure assessments and site assessments, and to evaluate and design potential corrective actions at leaking UST and spill sites. The Department of Energy (DOE), through an existing Interagency Agreement with the Air Force, provides technical assistance in implementing the UST assessment and remediation for the ANGRC. Martin Marietta Energy Systems, Inc. was assigned the responsibility of managing the Hazardous Waste Remedial Actions Program (HAZWRAP) for DOE. A Site Investigation (SI) Report was developed by Engineering Science, Inc. in March 1992. This CAP was prepared by PEER Consultants, P.C. (PEER), under the direction of HAZWRAP.

1.2 SITE DESCRIPTION

The 119th Fighter Interceptor Group of the NDANG is located adjacent to Hector Field near Fargo, in Cass County, North Dakota (Figure 1.1). The Base leases 133 acres in the southeastern corner of the airport from the city of Fargo, and has been in operation since 1947 [Engineering-Science (ES) 1991].

The following site descriptions were summarized from the SI Report (ES 1991).



SOURCE: USGS, FARGO NORTH QUADRANGLE, NORTH DAKOTA–MINNESOTA; ENGINEERING SCIENCE, INC., 1991

PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 1.1 LOCATION MAP NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 3070249102	SCALE: AS INDICATED
		REVISION NO. 0	FILE: FAR002.DWG

1.2.1 Site 2 -- Waste Oil Underground Storage Tank

The location of Site 2 is shown on Figure 1.2. The UST is marked at the surface by a stand pipe. It is unknown at this time whether the stand pipe was a fillport, vent, or other appurtenance. The site was originally identified as a storage area between the apron and Building 217. It is currently covered in grass and the area is not used by based personnel.

1.2.2 Site 10 -- Fire Training Area

The location of Site 10, the former fire training area, is shown on Figure 1.2. The site is located outside the NDANG boundary on property owned by the city of Fargo. The fire training area consists of an open, generally flat area with a burn pit and no confinement structure. The burn pit area is approximately 75 ft by 100 ft wide. Airplane debris are evident within the burn pit area. An irregular berm of soil with concrete debris and trees lies just west of the site, and a slight ridge of soil along the northeast side of the burn pit suggest a berm was also present in this region. Concrete debris are scattered over the site, and several drums, an abandoned bus, and a small building lie between the burn pit and a fence to the east. The burn pit area was noted to be devoid of vegetation during the site investigation (SI), except along the edges where grass was starting to return.

1.3 ENVIRONMENTAL SETTING

The following environmental setting was summarized from the SI Report (ES 1991).

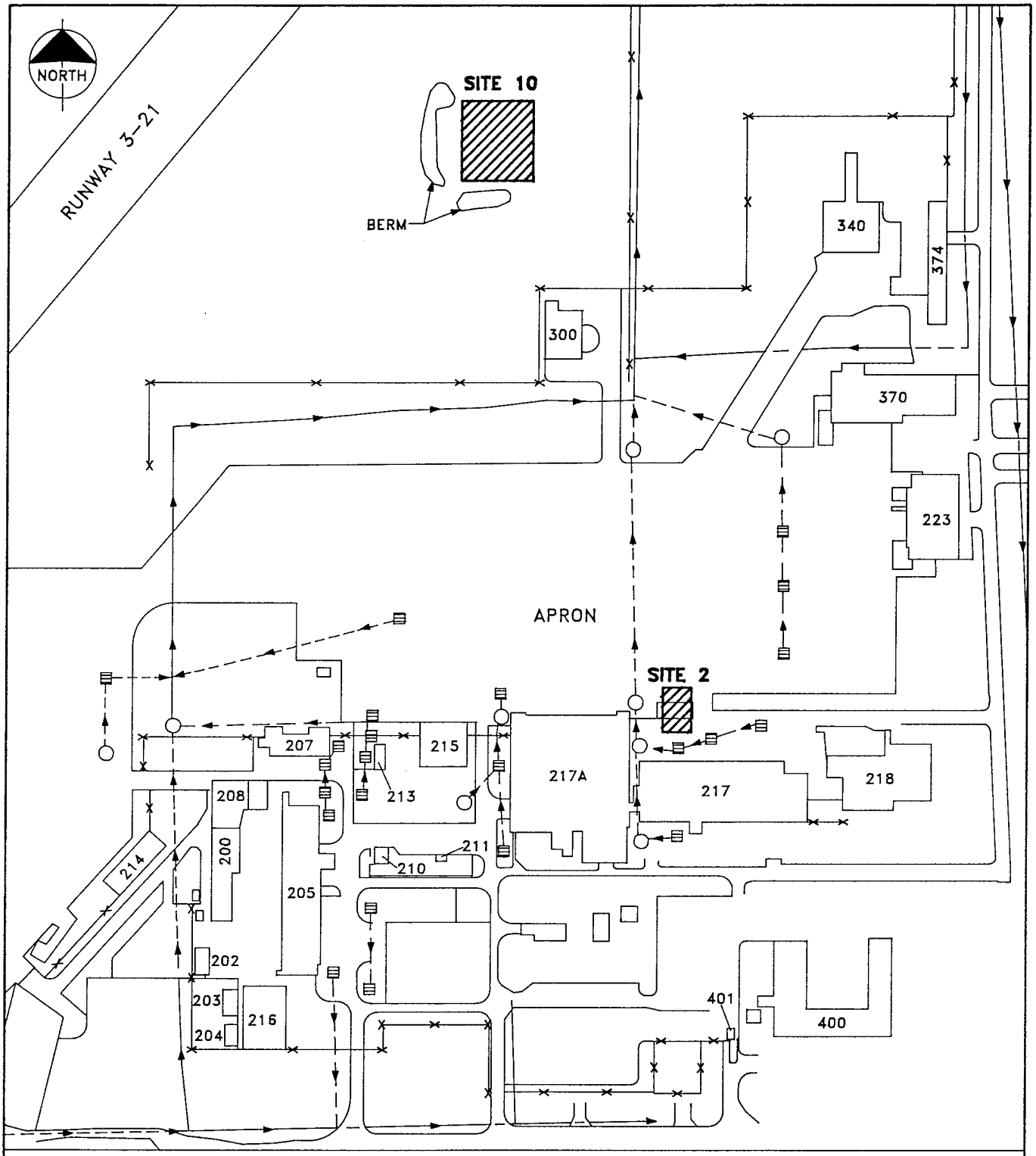
1.3.1 Meteorology

The climate in the vicinity of the NDANG Base is characterized by long, cold winters and short summers. The average daily temperature ranges from 20°F in the winter to 82°F in the summer. The mean annual precipitation is 21 in., which includes 16 in. of rainfall between April and September and 36 in. of snow. The prevailing wind is from the north.

1.3.2 Geology

The NDANG Base lies in the Central Lowland physiographic province on the Lake Agassiz Plain. Precambrian granite bedrock underlies approximately 200 ft of glacial deposits and 100 ft of lake plain deposits. A generalized stratigraphic section from a borehole southwest of the Base is shown on Figure 1.3.

The glacial deposits consist chiefly of till, a heterogenous mixture of silt and clay with subordinant amounts of sand, gravel, and boulders. The glacial deposits are overlain by about 100 ft of Pleistocene-age lake-plain materials which were deposited in glacial



0 250

SCALE IN FEET

SOURCE: ENGINEERING-SCIENCE, INC., 1991

LEGEND:

340 BUILDING AND NUMBER

FENCE

MANHOLE

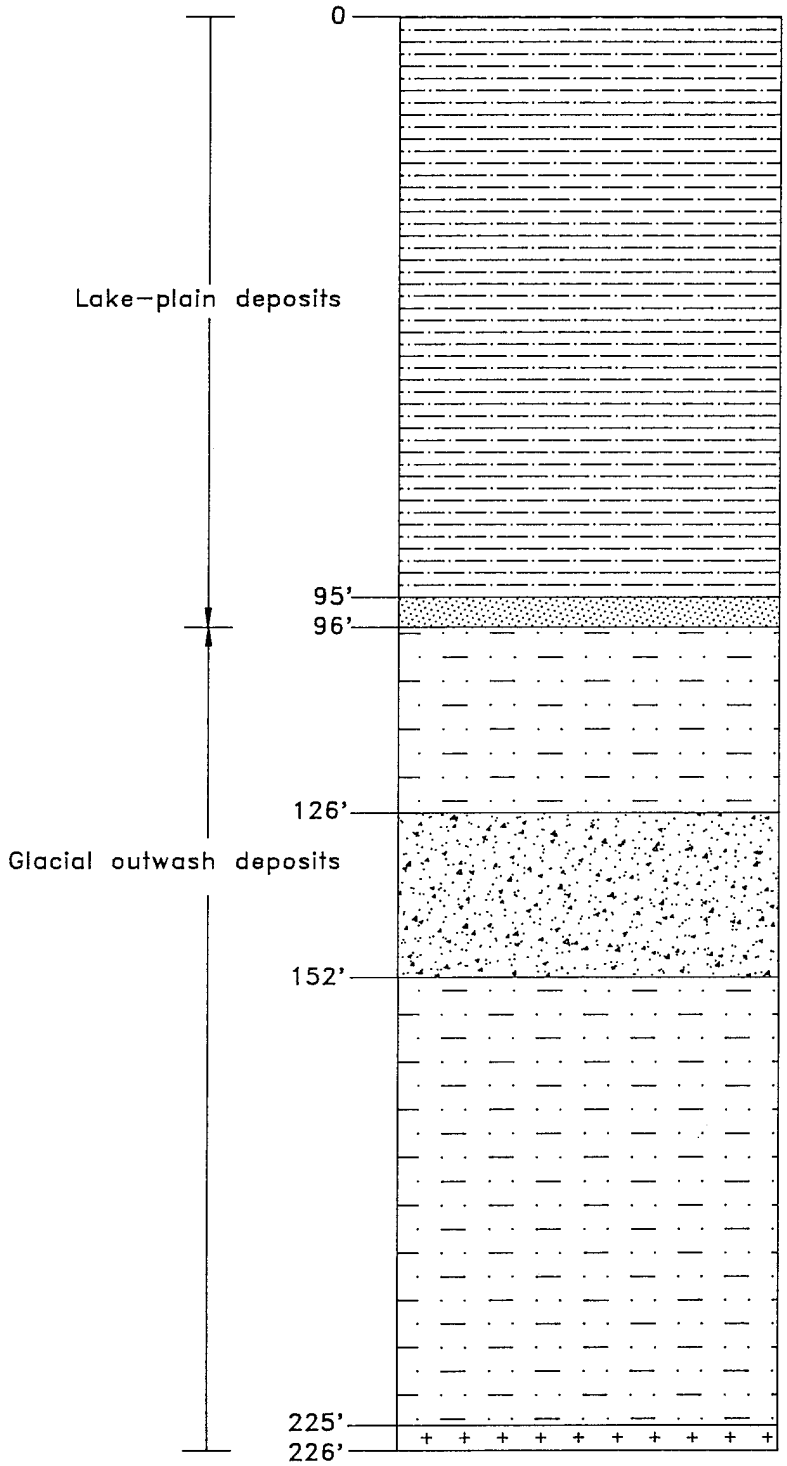
CATCH BASIN

NOTE: LOCATION OF CULVERTS HAS NOT BEEN INCLUDED.

OPEN SURFACE DRAINAGE DITCH

STORM SEWER

PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 1.2 LOCATION OF SITES 2 AND 10 NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 3070249102	SCALE: AS INDICATED
		REVISION NO. 1	FILE: FAR002.DWG



SOURCE: DRAFT SITE INVESTIGATION REPORT
NORTH DAKOTA AIR NATIONAL GUARD BASE,
HECTOR INTERNATIONAL AIRPORT, FARGO, NORTH DAKOTA;
ESI, 1991

PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 1.3 LITHOLOGIC DESCRIPTION OF A TEST BORING NEAR NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 1443K09	SCALE: AS INDICATED
		REVISION NO. 0	FILE: LITHOG.DWG

Lake Agassiz. The deposits are divided into an upper silty unit and a lower clay unit, however the upper unit was not recognized in a test boring near the Base. The lake-plain deposits include fluvial deposits which contain channel sands. These channel sands are lenticular in shape and occur at depths of 5-20 ft beneath the surface.

In the region of Site 2, a massive clay unit lies beneath the fill material (topsoil, sand, and gravel) to approximately 10 ft below ground surface (BGS). Below the clay unit is a unit of mottled clay with a thickness of about 5 ft. Underlying this unit is a layer of varved clay and silt with a thickness of approximately 10 ft.

In the region of Site 10, beneath the burn pit area is a layer of fill material consisting of topsoil, sand, and gravel, approximately 2 to 5 ft thick. Below this layer is a unit of massive clay with a thickness of approximately 3 ft. Underlying the massive clay is a unit of mottled clay approximately 8 ft thick. Beneath this is a unit of varved clay and silt approximately 15 ft thick with lenses of cross-bedded silts and fine sands.

1.3.3 Soils

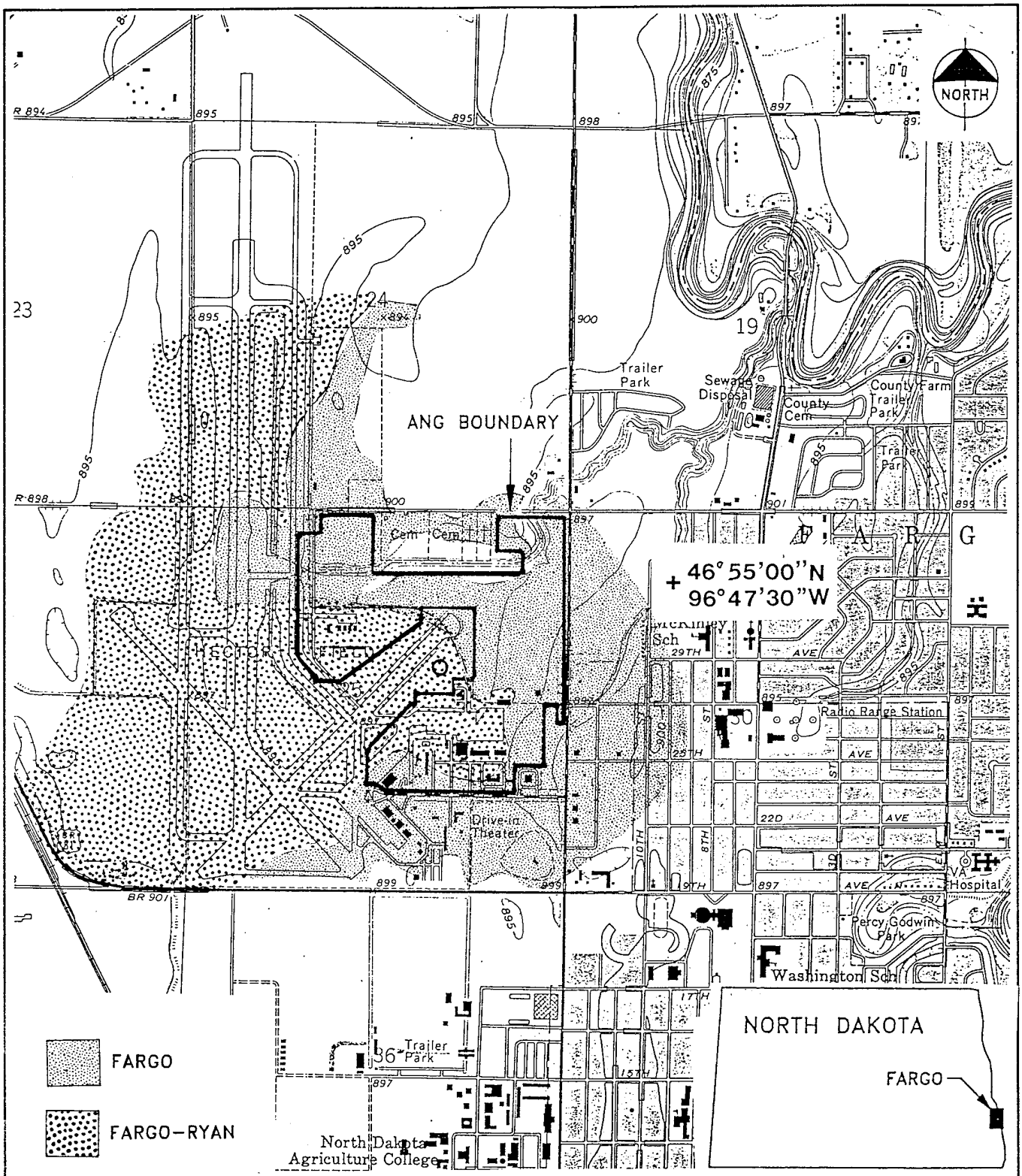
Two soil units have been described at the NDANG Base: the Fargo silty clay, and the Fargo-Ryan silty clays. Both soil units were derived from glacial lacustrine sediment. The distribution of these soil types is shown on Figure 1.4.

The Fargo silty clay is a deep, poorly drained soil approximately five feet in thickness. The uppermost layer consists of about 10 inches of black silty clay, and is underlain by dark gray and dark olive gray silty clay. The clay content of the Fargo silty clay locally exceeds 60%. The permeability of the Fargo silty clay ranges from 1×10^{-4} cm/sec to 4×10^{-5} cm/sec.

The Fargo-Ryan silty clays consist of patches of Fargo silty clay and Ryan silty clay too small to be mapped individually. The Ryan silty clay is similar to the Fargo silty clay described above, differing primarily by its occurrence in slight depressions, by being sodic and saline, and having a permeability of less than 4×10^{-5} cm/sec.

1.3.4 Surface Water

The NDANG Base lies in the Red River drainage basin. There are no natural drainage systems or streams on the Base. Surface runoff is primarily by overland flow which is collected into a series of storm sewers, culverts, and open drainage ditches. These discharge to an open drainage ditch east of Site 10 and eventually discharge into the Red River, which lies about two miles east of the Base.



SOURCE: SOIL SURVEY OF CASS COUNTY AREA, NORTH DAKOTA; USDA SOIL CONSERVATION SERVICE

PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 1.4 DISTRIBUTION OF SOIL TYPES IN THE VICINITY OF NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 1443K09	SCALE: AS INDICATED
		REVISION NO. 0	FILE: LITHOG.DWG

1.3.5 Hydrogeology

During the SI, groundwater was encountered at depths from 4.5 to 7 ft BGS at Site 2; at Site 10, groundwater was encountered at depths from 6 to 7 ft BGS.

Regional groundwater flow is toward the Red River. Low permeability and low hydraulic gradient result in groundwater velocities in the range of approximately 1.5 ft/yr (0.5 m/yr). The SI indicated that a number of distinct hydrogeologic units are present in the vicinity of the NDANG Base. These include an unconfined aquifer, channel sand aquifers (both of which are contained in the Lake Plain deposits), the Fargo and West Fargo aquifers, which are contained in the underlying glacial outwash deposits. A generalized stratigraphic section (adapted from the SI) showing the relationship between the lake-plain and glacial outwash units is shown on Figure 1.3. However, the hydrogeologic units are not resolved on the stratigraphic section.

Unconfined groundwater in the Lake-Plain deposits occurs at an average depth of 6-8 ft BGS, but these deposits are not significant sources of groundwater due to the low yield. Unconfined groundwater also occurs in the channel sand deposits, which have been mapped in the vicinity of the Base, occur at depths of 5-20 ft BGS, and range in thickness up to 60 ft. Use of the channel sand aquifers in the past has been limited to individual domestic and farm production water supplies. A survey revealed limited information on pumping from this aquifer.

The Fargo and West Fargo aquifers are important sources of groundwater in Cass County. Both aquifers are confined and recharge is slow. The Fargo and West Fargo Aquifers are both comprised of glacial outwash deposits of fine- to coarse-grain sand interbedded with gravel. The top of the Fargo Aquifer, which has an average thickness of about 45 ft, is present at a depth of approximately 100 ft BGS. The West Fargo Aquifer has an average thickness of about 60 ft. The Fargo and West Fargo Aquifers do not appear to be hydrologically connected. The aquifers are currently used for individual domestic and farm production water supplies.

A summary of the hydrogeologic data from the SI Report is provided in Table 1.1. Hydraulic conductivity of unconsolidated material at the two sites was calculated during the course of the SI, and found to range from 7×10^{-6} cm/sec to 5×10^{-4} cm/sec at Site 2, and 7×10^{-6} cm/sec to 3×10^{-5} cm/sec at Site 10. The direction of groundwater flow at the Base was found to be variable. In the vicinity of Site 2, groundwater appears to be mounded over the UST pit, and flows radially away from the tank at a gradient of 0.01 ft/ft to 0.003 ft/ft. In the vicinity of Site 10, groundwater flows toward the southeast and northeast at a gradient of 0.002 ft/ft.

Table 1.1

Summary of Hydrogeologic Data for Site 2 and Site 10
North Dakota Air National Guard Base
Hector Field, Fargo

Site	Monitoring Well	Hydraulic Conductivity (cm/s)	Groundwater Velocity (ft/yr)	Hydraulic Gradient (ft/ft)
2	MW8 & MW9	7×10^{-6} 5×10^{-6}	0.09 - 26	0.003 - 0.01
10	MW2 & MW5	3×10^{-5} 7×10^{-6}	0.02 - 0.23	0.002 typical

Source: Engineering Science, 1991

2.0 SITE HISTORY

An SI Report for the NDANG Base was previously prepared by ES (1991) for the ANGRC in August 1991, as a part of the Installation Restoration Program. Hydrocarbon contamination was detected in shallow soils (to 13 ft BGS) in the area surrounding the UST at Site 2. The horizontal extent of this contamination appeared to be limited because this contamination was not detected in the shallow wells surrounding the site (ES 1991). Hydrocarbon contamination was also detected in the near-surface soils (to 15 ft BGS) within the immediate area of the burn pit at Site 10, the former fire training area (ES 1991), in addition to the presence of chlorinated organics.

The information contained in the following section has been summarized from the SI Report (ES 1991).

2.1 SITE 2

At Site 2, the UST was installed in 1959, and taken out of service around 1984. The UST (tank and piping) had not been removed, according to Base personnel, as of January 1994. The 300-gal nominal capacity steel UST was used to store waste oils. The tank was reported to have a hole in it which allowed leaks. According to Base personnel, the UST was pumped free of oil at the time of closure.

During the SI in 1991, field screening (soil-gas and soil headspace) was conducted, and nine soil borings, three monitoring wells, and three piezometers were installed. Groundwater and soil samples were collected and analyzed. Results of the SI indicated that hydrocarbon contamination in the soil is limited in depth to 13 ft BGS and in horizontal extent to the immediate area around the UST. A summary of the analytical results is presented in Section 2.3.

The UST and any grossly contaminated soils in the immediate area of the pit have been identified for removal, and treatment with the soils at Site 10.

2.2 SITE 10

Fire training exercises occurred every three months from the late 1950s to 1983 at the former fire training area. Between 1983 and mid-1989, the exercises were conducted every two months. Approximately 300 to 400 gal of JP-4 (jet fuel) were used during each exercise. Use of organic solvents was reportedly minimal. Between 1987 and 1989, fire training exercises were conducted using pans to restrict seepage of these materials into the soils. The exercises were stopped in 1989.

During the SI in 1991, soil gas and soil headspace screenings were conducted, and seven soil borings and five monitoring wells were installed. Groundwater and soil samples were collected and analyzed. The results of the SI indicated that the extent of

hydrocarbon contamination in the soil was found to be limited to the immediate vicinity of the burn pit. According to information contained in the SI Report, this area is approximately 75 ft by 100 ft wide and up to 15 ft deep. During the SI, petroleum odors were also noted in the area. A summary of the analytical results is presented in Section 2.3.

The contaminated soils are scheduled to be removed and treated on site.

2.3 CONTAMINATION ASSESSMENT

2.3.1 Site 2 - Waste Oil Underground Storage Tank

At Site 2, the objective of the SI was to determine the extent of contamination resulting from leakage of the 300-gal UST which had been used to store waste hydraulic oils. The SI included performing a soil-gas/soil headspace survey, advancing nine soil borings, installing three piezometers and three monitoring wells, and collecting and analyzing soil and groundwater samples. A summary of the results from the analyses for volatile organic compounds (excluding the soil-gas/soil headspace survey) is provided in Table 2.1. A detailed presentation of the full analytical results is available in the SI Report (ES 1991).

Soil-Gas/Soil Headspace Survey

A soil-gas survey was attempted at Site 2, but was not successful due to the site geology. Collection of soil samples from soil borings and headspace analysis was used as an alternative. The location of the soil borings are shown on Figure 2.1. Soil samples were screened for halogenated volatile organics, and aromatic hydrocarbons. The main contaminants detected were fuel components (benzene, toluene, ethylbenzene, and xylenes). Hydrocarbons were the most common compounds detected, and xylenes occurred the most frequently and at the highest concentrations. Hydrocarbons were detected in all soil borings except 2-BH2OR.

An isocontour map showing the distribution of xylenes is shown on Figure 2.2. Benzene, toluene, and ethylbenzene were also detected in the headspace samples. The vertical and horizontal distribution of xylenes is shown on Figure 2.3. Hydrocarbon contamination in the soil was detected below the water table at all locations near the UST except soil boring 2-BH2OR.

Soils

Seven soil samples were submitted for laboratory analysis for volatile and semivolatile organic compounds, 13 priority pollutant metals, and polychlorinated biphenyls (PCBs), and one sample was submitted for analysis of the extract obtained from the toxicity characteristic leaching procedure (TCLP).

Table 2.1

Summary of Volatile Organic Compounds Detected in Site 2 Samples

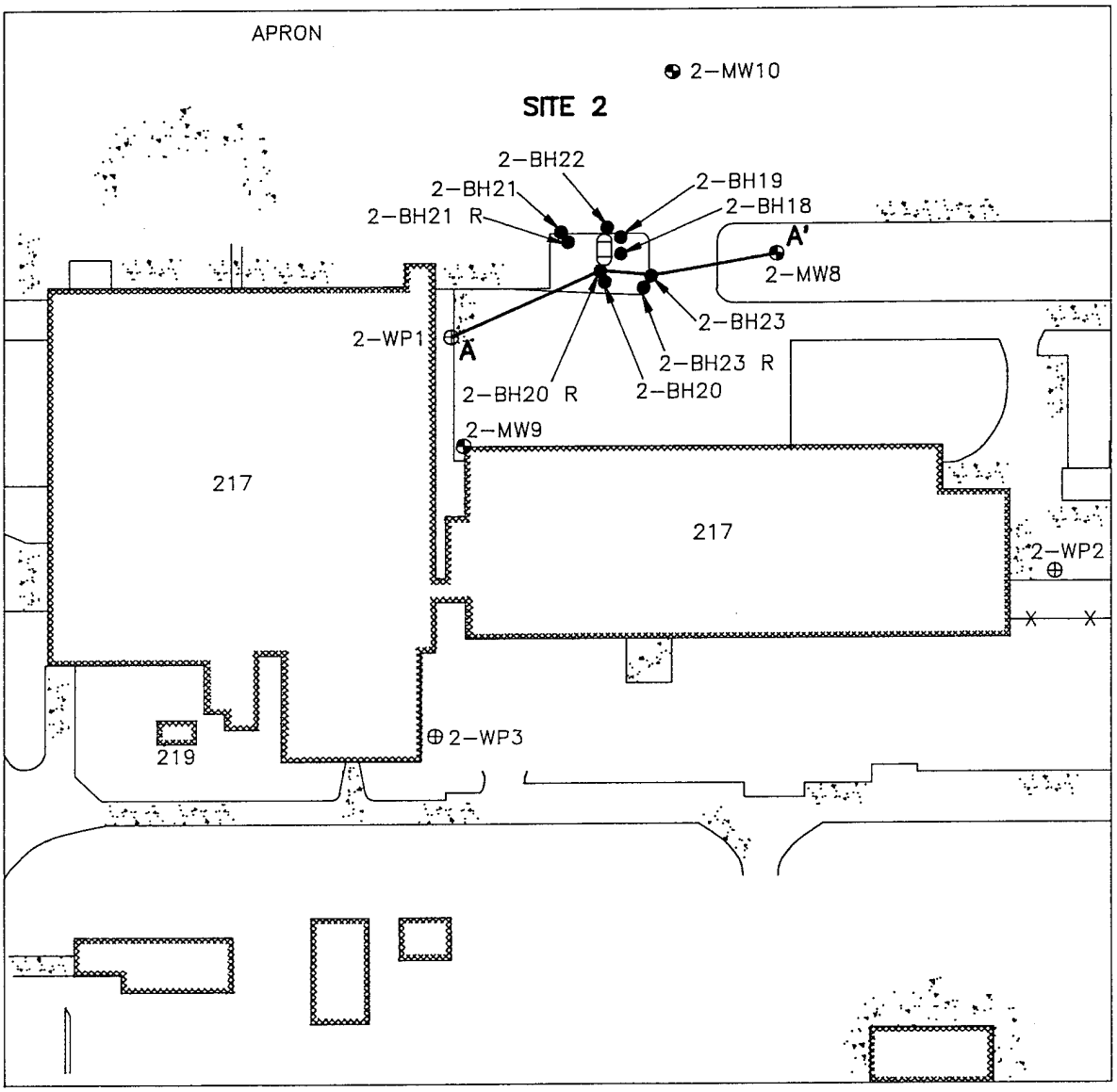
HECTOR FIELD, FARGO, NORTH DAKOTA

Sample Location	Sample Depth (feet)	Parameter							
		Acetone	Benzene	Carbon Disulfide	Tetra-chloroethene	Toluene	Ethyl-benzene	meta- and para-Xylenes	ortho-Xylene
Soil Samples (ug/kg)									
NDANG-2-BH18-SS1(2)	7-8	8300 UJ	4200 U	8300 UJ	4200 U	8700	32000	11000 J	40000 J
NDANG-2-BH18-SS9	7-8	83000 U	4200 U	8300 U	4200 U	5800	34000	11000 J	37000 J
NDANG-2-BH19-SS1	6-8	160000 U	8100 U	16000 U	8100 U	100000	70000	22000 J	83000 J
NDANG-2-BH20-SS1	6-8	130 U	7 U	13 U	7 U	7 U	7 U	7 U	7 U
NDANG-2-BH21-SS1	6-8	160 J	34 U	67 U	34 U	27 J	400	670	190
NDANG-2-BH23-SS1	6.5-8	140 J	34 U	67 U	34 U	20 J	150	130	39
NDANG-2-MW8-SS1	6-8	130 U	6 U	13 U	6 U	6 U	6 U	6 U	6 U
TCLP (ug/L)									
NDANG-2-BH19-SS1	6-8	1000 U	74	100 U	50 U	2000	680	2100 J	940 J
Groundwater (ug/L)									
None	--	No volatile organic compounds were detected in groundwater.							

1. Data qualifiers follow the data. The qualifiers are defined as follows:
   U - indicates element was analyzed for but not detected; number preceding the "U" is the detection limit;
   J - the concentration reported is an estimate; and
   B - indicates that the compound was detected in the laboratory blank.

2. The compound, 4-methyl-2-pentanone, was detected at 49000 ug/kg in sample NDANG-2-BH18-SS1, but was below the detection limit of 42,000 ug/kg in the duplicate.

Abbreviations:
TCLP - Toxic Characteristic Leaching Procedure; and
-- - not applicable.



BASE FROM NORTH DAKOTA AIR NATIONAL GUARD DOCUMENTS.
SOURCE: ENGINEERING SCIENCE, INC., 1991

LEGEND:

2-MW8	MONITORING WELL AND NUMBER		UNDERGROUND STORAGE TANK
2-BH21	SOIL BORING AND NUMBER	217	BUILDING AND NUMBER
2-WP1	PIEZOMETER AND NUMBER		
	PAVED AREA		GRASSY AREA
A——A'	LOCATION OF CROSS-SECTION (SEE FIGURE 2.3)	-X-X-	FENCE

NORTH

0 50 100
SCALE IN FEET

PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 2.1 SITE 2-LOCATION OF SOIL BORINGS, MONITORING WELLS, AND PIEZOMETERS NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 1443K09	SCALE: AS INDICATED
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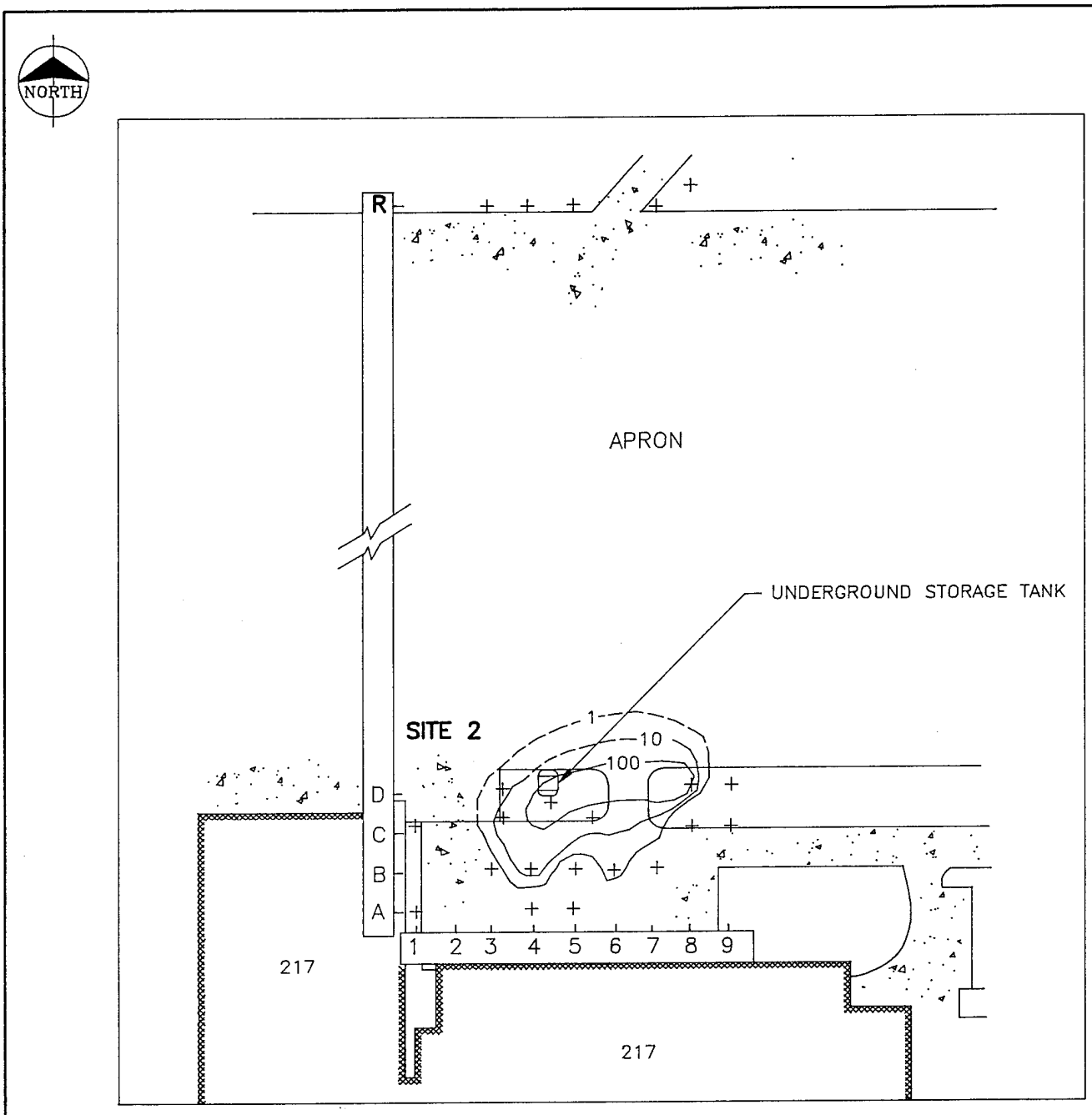


LEGEND:

+ SOIL HEADSPACE SAMPLING LOCATION

217 BUILDING AND NUMBER

PAVED AREA

GRASSY AREA

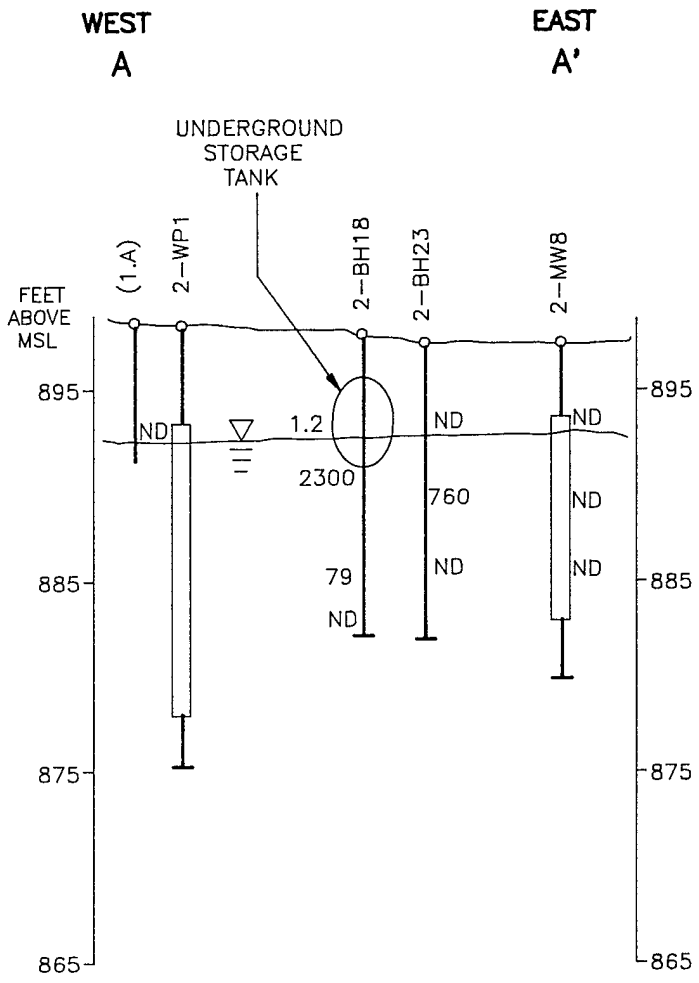
—10— TOTAL XYLENES CONCENTRATION CONTOUR. SHOWS LEVEL OF TOTAL XYLENES IN MICROGRAMS PER LITER OF HEADSPACE.

0 50 100

SCALE IN FEET

SOURCE: ENGINEERING SCIENCE, INC., 1991

PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 2.2 ISOCONTOURS OF XYLENES IN SOIL HEADSPACE MEASUREMENTS AT DEPTHS OF 3 TO 6 FEET NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 1443K09	SCALE: AS INDICATED
		REVISION NO. 1	FILE: ISO-XYLE.DWG



LOCATION OF CROSS-SECTION IS SHOWN ON FIGURE 2.1

LEGEND:

WATER TABLE

2-BH18 | 79 — DRILLING LOCATION AND IDENTIFIER. THE NUMBERS BESIDE THE BOREHOLES REFER TO THE CONCENTRATION OF TOTAL XYLENES IN MICROGRAMS PER LITER OF HEADSPACE. "ND" MEANS NOT DETECTED.

(1,A) — SOIL HEADSPACE LOCATION AND GRID IDENTIFIER.

2-WP1 — PIEZOMETER LOCATION

2-MW8 — MONITORING WELL LOCATION

0 50 100
SCALE IN FEET

SOURCE: ENGINEERING SCIENCE, INC., 1991

PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 2.3 SITE 2-VERTICAL DISTRIBUTION OF TOTAL XYLENES FROM SOIL HEADSPACE NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 1443K09 FILE: XYLENES.DWG	SCALE: AS INDICATED
		REVISION NO. 0	DSGN BY: D. HINES DWN BY: C. HALL

Several volatile organic compounds, including acetone, toluene, ethylbenzene, and total xylenes were detected at concentrations exceeding 1000 μg/kg, with concentrations generally decreasing with depth. Semivolatile organic compounds were detected including naphthalene, 2-methylnapthalene, and phthalates (which may be a result of laboratory contamination). Levels of metals detected in the soil samples were comparable with those detected in the background sample. PCBs were not detected in any of the soil samples. Benzene, ethylbenzene, and xylenes were detected in the TCLP extract from a sample collected from 6 to 8 ft BGS in soil boring 2-BH19.

Groundwater Sampling

The locations of the monitoring wells and piezometers were shown on Figure 2.1. Groundwater samples were collected from the three monitoring wells and from one of the piezometers and submitted for laboratory analysis for volatile and semivolatile organic compounds, 13 priority pollutant metals, and PCBs. No volatile organic compounds nor PCBs were detected in any of the samples. One semivolatile organic compound was detected, bis(2-ethylhexyl)phthalate, at a concentration of 120 μg/L. Except for arsenic, the levels of metals detected were comparable with those detected in the background well. Arsenic was detected at a maximum level of 17.5 μg/L in the sample taken from 2-WP 1; however, analysis of soils at the site did not contain elevated levels of arsenic.

Summary of SI Findings

The results from the soil headspace survey and the soil boring samples indicate that petroleum-hydrocarbon contamination is present at a depth of between 4 to 5 feet BGS in the area surrounding the UST (Figure 2.2). Although volatile organics (indicative of petroleum-hydrocarbon contamination) were not detected in the monitoring wells or piezometer at this site, contamination in groundwater is suspected in the immediate area of the UST since a strong petroleum odor was noted and a sheen was observed on the water in the soil borings left open overnight. It was concluded in the SI that contaminants in the groundwater were not likely to migrate due to the low hydraulic conductivity and the low groundwater flow gradients, and therefore, were not detected in the monitoring wells located 60 to 100 ft from the UST. It should also be noted, however, that during the course of the SI, no samples from Site 2 were submitted for analysis for Total Petroleum Hydrocarbons, for which the state of North Dakota has defined specific regulatory requirements for the closure of petroleum release sites which are described in Section 3.1.1.

2.3.2 Site 10 - Fire Training Area

At Site 10, the objective of the SI was to determine the extent of soil and groundwater contamination and whether contaminants are entering the drainage ditch to the east of the fire training pit. The SI included performing a soil-gas survey and soil headspace

Table 2.2

Summary of Volatile Organic Compounds Detected in Site 10 Samples

HECTOR FIELD, FARGO, NORTH DAKOTA

Sample Location	Sample Depth	Parameter							
		Acetone	Carbon Disulfide	Benzene	Tetra-chloroethene	Toluene	Ethyl-benzene	meta- and para-Xylenes	ortho-Xylene
Soil Samples (ug/kg)									
NDANG-10-BH1-SS1	1-2	1000000 U (2)	17000 U	8400 U	8400 U	170000	40000	370000	150000
NDANG-10-BH1-SS1A	1-2	140 U	14 U	7 U	7 U	7 U	7 U	7 U	7 U
NDANG-10-BH1-SS3(3)	9-10	140 U	14 U	7 U	7 U	7 U	7 J	14	5 J
NDANG-10-BH1-SS4	14-15	140 U	14 U	7 U	7 U	7 U	5 J	8	7 U
NDANG-10-BH2-SS1	0-2	120 U	12 U	6 U	6 U	6 U	6 U	6 U	6 U
NDANG-10-BH2-SS2	9-10	16 J	14 U	7 U	7 U	4 J	140	23	7 U
NDANG-10-BH3-SS1	5-7	68000 U	6800 U	3400 U	3400 U	3400 U	3600	13000	3400 U
NDANG-10-BH4-SS1	2-3	31000 U	3100 U	1600 U	1600 U	21000	16000	59000	20000
NDANG-10-BH4-SS3	14-15	2000 J	1800 U	900 U	900 U	710 J	2700	5300	790 J
NDANG-10-BH5-SS1	5-7	17000 U	1700 U	1900	850 U	13000	5900	18000	7100
NDANG-10-BH5-SS2	12-13	150 U	15 U	8 U	8 U	8 U	8 U	8 U	8 U
NDANG-10-BH6-SS1	5-7	17000 U	1700 U	840 U	840 U	1800	1700	4600	2400
NDANG-10-BH6-SS1A	5-7	17000 U	1700 U	830 U	830 U	2200	1500	3900	1900
NDANG-10-BH7-SS1	5-7	17000 U	1700 U	850 U	850 U	4900	5600	11000	4800
NDANG-10-BH7-SS2	14-15	150 U	15 U	8 U	8 U	8 U	8 U	8 U	8 U
NDANG-10-MW2-SS1	8-9	140 U	14 U	7 U	7 U	5 J	7 U	7 U	7 U
NDANG-10-MW3-SS1	9-10	140 U	14 U	7 U	7 U	7 U	7 U	7 U	7 U
NDANG-10-MW4-SS1	9-10	140 U	14 U	7 U	7 U	7 U	7 U	7 U	7 U
NDANG-10-MW5-SS1	5-7	140 U	14 U	7 U	9	7 U	7 U	7 U	7 U
NDANG-10-MW6-SS1	8-10	17000 U	1700 U	870 U	8700 U	870 U	1400	530 J	180 J
NDANG-10-BH1R-SS1	0-2	34000 U	3400 U	5200	1700 U	36000	9100	98000	74000
NDANG-10-BH1R-SS1A	0-2	17000 U	1700 U	850 U	850 U	850 U	850 U	160000	150000

Table 2.2 (Cont.)

Sample Location	Sample Depth	Parameter							
		Acetone	Carbon Disulfide	Benzene	Tetra-chloroethene	Toluene	Ethyl-benzene	meta- and para-Xylenes	ortho-Xylene
TCLP (ug/L)									
NDANG-10-MW6-SS1	8-10	100 U	10 U	5 U	5 U	6	73	39	18
Groundwater (ug/L)									
NDANG-10-MW2	--	100 U	11 U	5 U	5 U	5 U	5 U	5 U	5 U
NDANG-10-MW5	--	100 U	6 J	5 U	5 U	5 U	5 U	5 U	5 U
NDANG-10-MW6	--	100 U	10 U	5 U	5 U	5 U	5 U	5	5 U
NDANG-10-MW6 Dup(4)	--	100 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U

Abbreviations:

TCLP - Toxic Characteristic Leaching Procedure; and
-- - not applicable.

1. In feet below ground surface.
2. Data qualifiers follow the data. The qualifiers are defined as follows:
   U - indicates element was analyzed for but not detected; number preceding the "U" is the detection limit;
   J - the concentration reported is an estimate; and
   B - indicates that the compound was detected in the laboratory blank.
3. It is believed that VOA soil samples for NDANG-10-BH1-SS3 and NDANG-10-BH4-SS3 were switched by the laboratory since the headspace screening results suggest this and some confusion was noted on the chain-of-custody regarding sample numbers (see Data Package 2245A).
4. Field laboratory ID of this sample is NDANG-10-MW12.

screenings, advancing eight soil borings, installing six monitoring wells, and collecting and analyzing soil and groundwater samples. A summary of the results from the analyses for volatile organic compounds (excluding the soil-gas/soil headspace screening) is provided in Table 2.2. A detailed presentation of the full analytical data is available in the SI Report (ES 1991).

Soil-Gas Survey

The principal contaminants detected in the soil-gas survey were fuel components (benzene, toluene, and xylenes). The distribution of total hydrocarbons at depths of 3 and 6 ft BGS is shown on Figure 2.4. The results indicated that contaminant concentrations decreased substantially with depth, and that hydrocarbon contamination was only detected in the immediate vicinity of the burn pit. The shape of contaminant distribution was determined to be that of a cone pointed downward in the center of the burn pit area. Contaminant plumes migrating from this area were not detected.

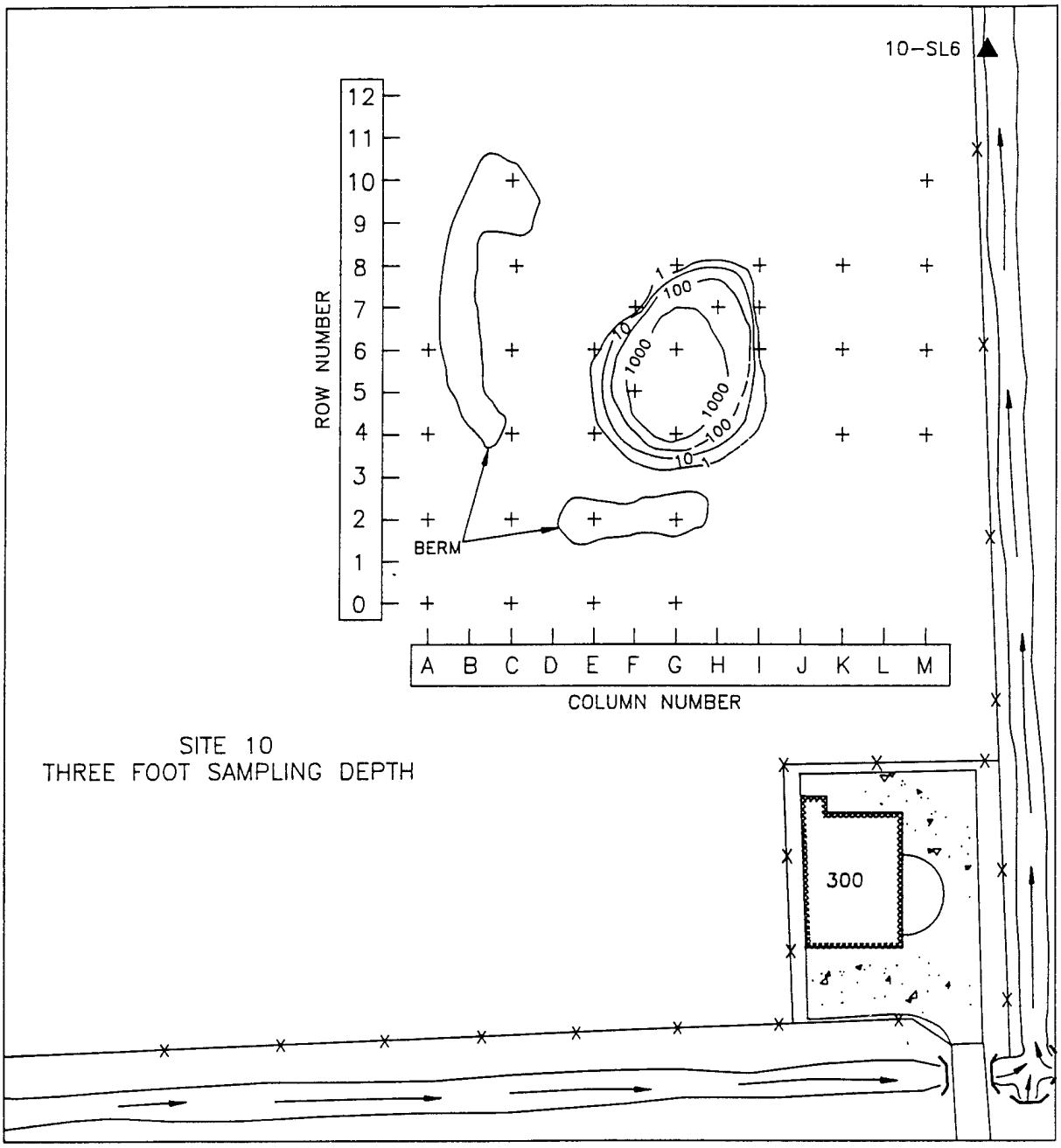
Soil Headspace Screening

The locations of the soil borings are shown on Figure 2.5. Soil samples were collected from the soil borings and soil headspace screenings were conducted. Fuel components (benzene, toluene, ethylbenzene, and xylenes) and two chlorinated solvents (trichloroethene, and tetrachloroethane) were detected in soil samples collected from boreholes in the burn-pit; however, none of the compounds were detected in the headspace of soil samples collected beyond the edge of the burn pit. The vertical distribution of hydrocarbons detected in the headspace screening is shown on Figure 2.6. It should also be noted that although the two chlorinated solvents were detected in the soil headspace screening trichloroethene was not detected above the detection limit in any of the soil and groundwater samples submitted for laboratory analysis; tetrachloroethene was detected in one soil sample at a concentration of 9 μg/kg.

Soils

The location of soil borings is shown on Figure 2.5. Soil samples were collected and analyzed for volatile organic and semivolatile organic compounds, 13 priority pollutant metals, and PCBs. One soil sample from 10-MWG was selected for the TCLP Method and the extract analyzed for all of these compounds.

Benzene, toluene, ethylbenzene, and xylenes were detected at concentrations greater than 1000 μg/kg in several soil samples from the burn pit area. Concentrations decreased with depth, although the depth of contamination varied from boring to boring. Phenols were detected in four samples with concentrations ranging from 170 to 1200 μg/kg. Naphthalene was detected in seven samples with concentrations ranging from 21 to 12,000 μg/kg. Phalates, common lab contaminants, occurred in several samples ranging from 7 to 3500 μg/kg.



SITE 10
THREE FOOT SAMPLING DEPTH

LEGEND:

10 — TOTAL VOLATILE HYDROCARBONS CONCENTRATION CONTOUR. SHOWS LEVEL IN SOIL-GAS, IN MICROGRAMS PER LITER. INTERVAL VARIABLE, DASHED WHERE INFERRED

SURFACE DRAINAGE SHOWING FLOW DIRECTION

CULVERT ENTRANCE (

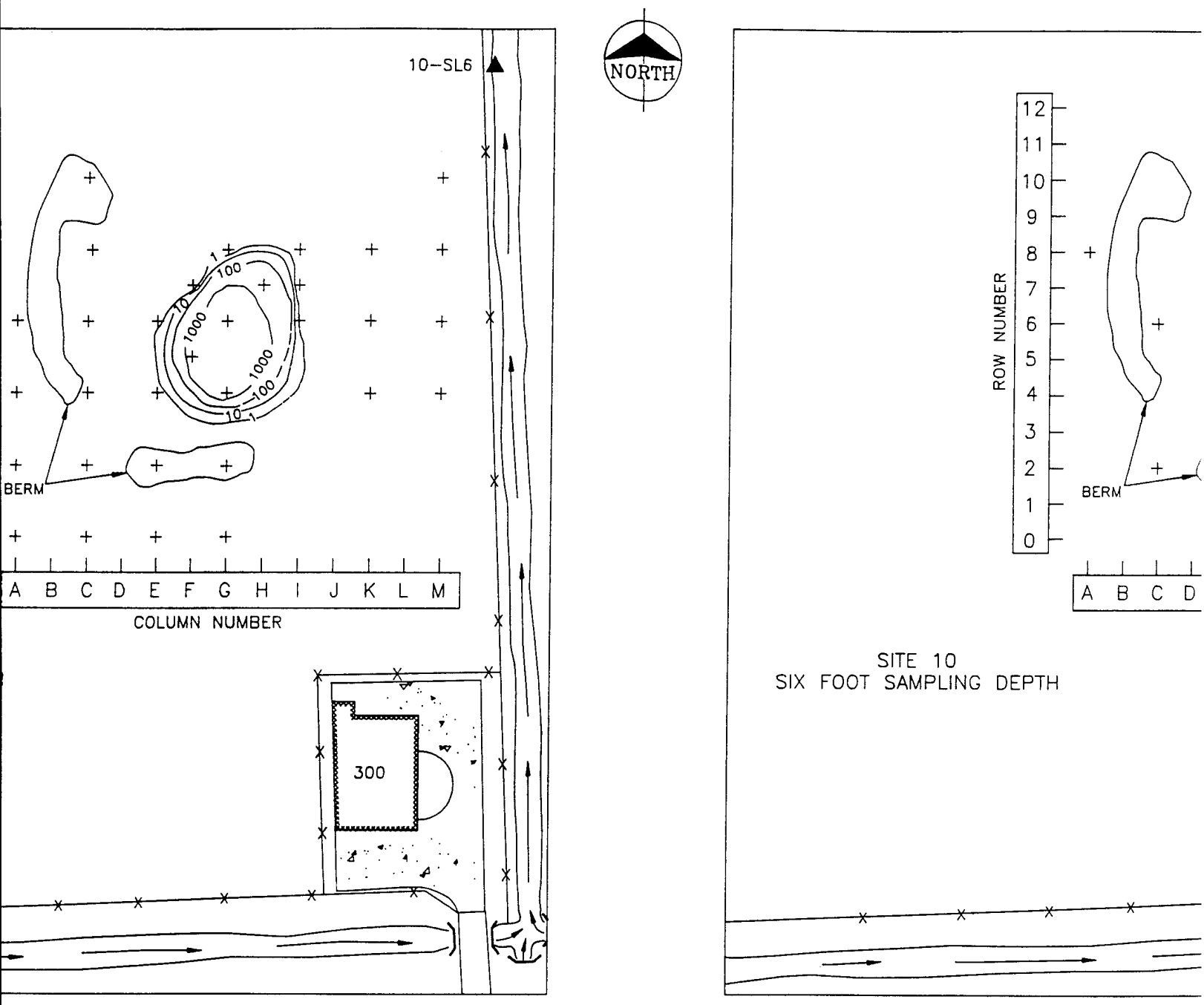
300 — BUILDING AND NUMB

\+ SOIL-GAS SAMPLING

SOURCE: ENGINEERING SCIENCE, INC., 1991

0 50 100
SCALE IN FEET

PEER
CONSULTANTS, P.C. ENGINEERS · SCIENTISTS
575 Oak Ridge Turnpike · (



SITE 10
SIX FOOT SAMPLING DEPTH

OCARBONS CONCENTRATION
EVEL IN SOIL-GAS, IN MICROGRAMS
VARIABLE, DASHED WHERE INFERRED

HOWING FLOW DIRECTION

CULVERT ENTRANCE OR EXIT

300 BUILDING AND NUMBER

\+ SOIL-GAS SAMPLING LOCATION

FENCE

PAVED AREA

GRASSY AREA

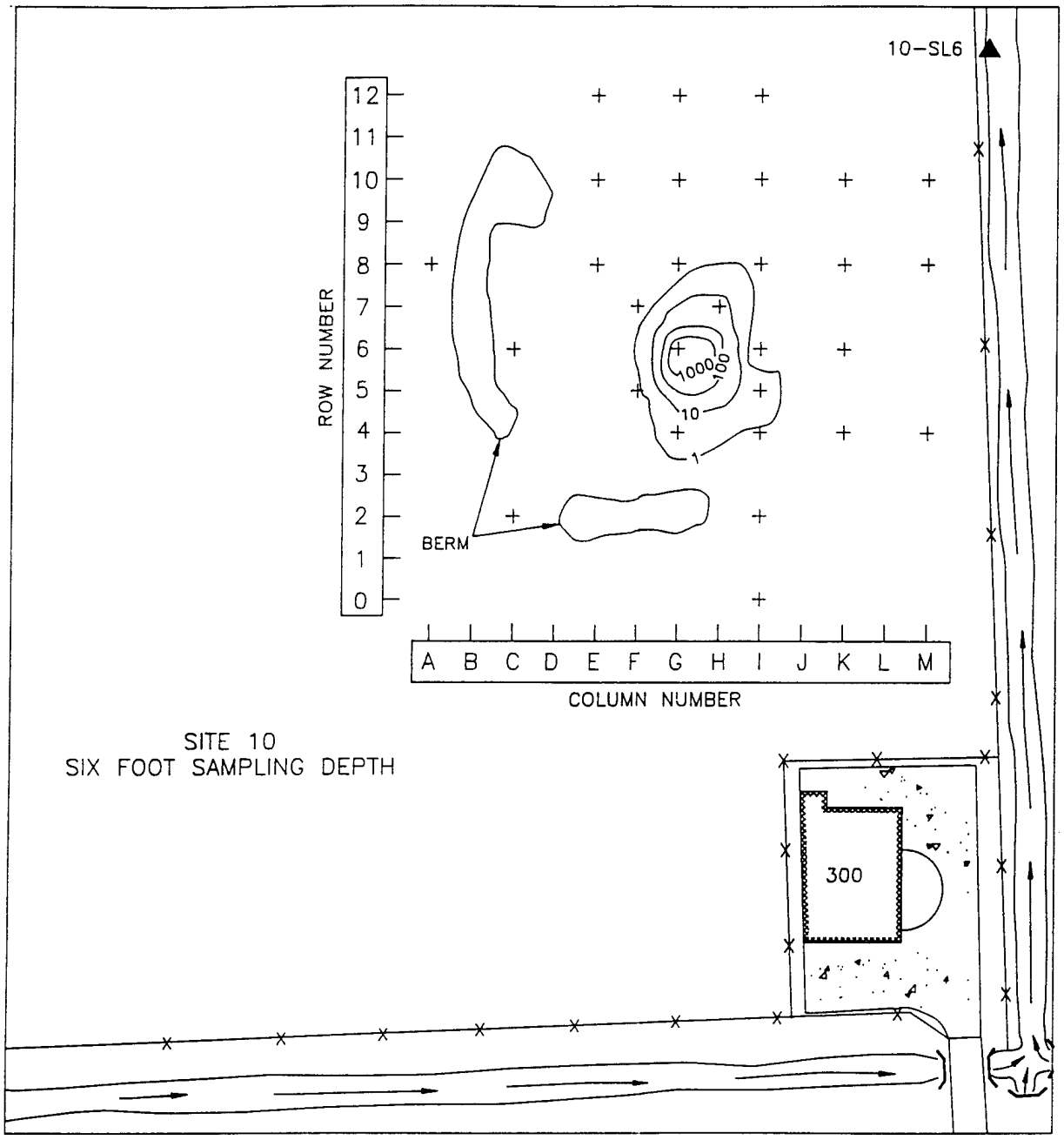
10-

0 50 100
SCALE IN FEET

PEER
CONSULTANTS, P.C. ENGINEERS · SCIENTISTS · MANAGEMENT CONSULTANTS

575 Oak Ridge Turnpike · Oak Ridge, TN 37830 · (615)483-3191

FIGURE 2.4 SITE 10-TOTAL VOLATIL
CONCENTRATIONS IN SOIL-
DEPTHS OF THREE AND S
NORTH DAKOTA AIR NATIONAL
HECTOR FIELD, FARG



XIT

FENCE

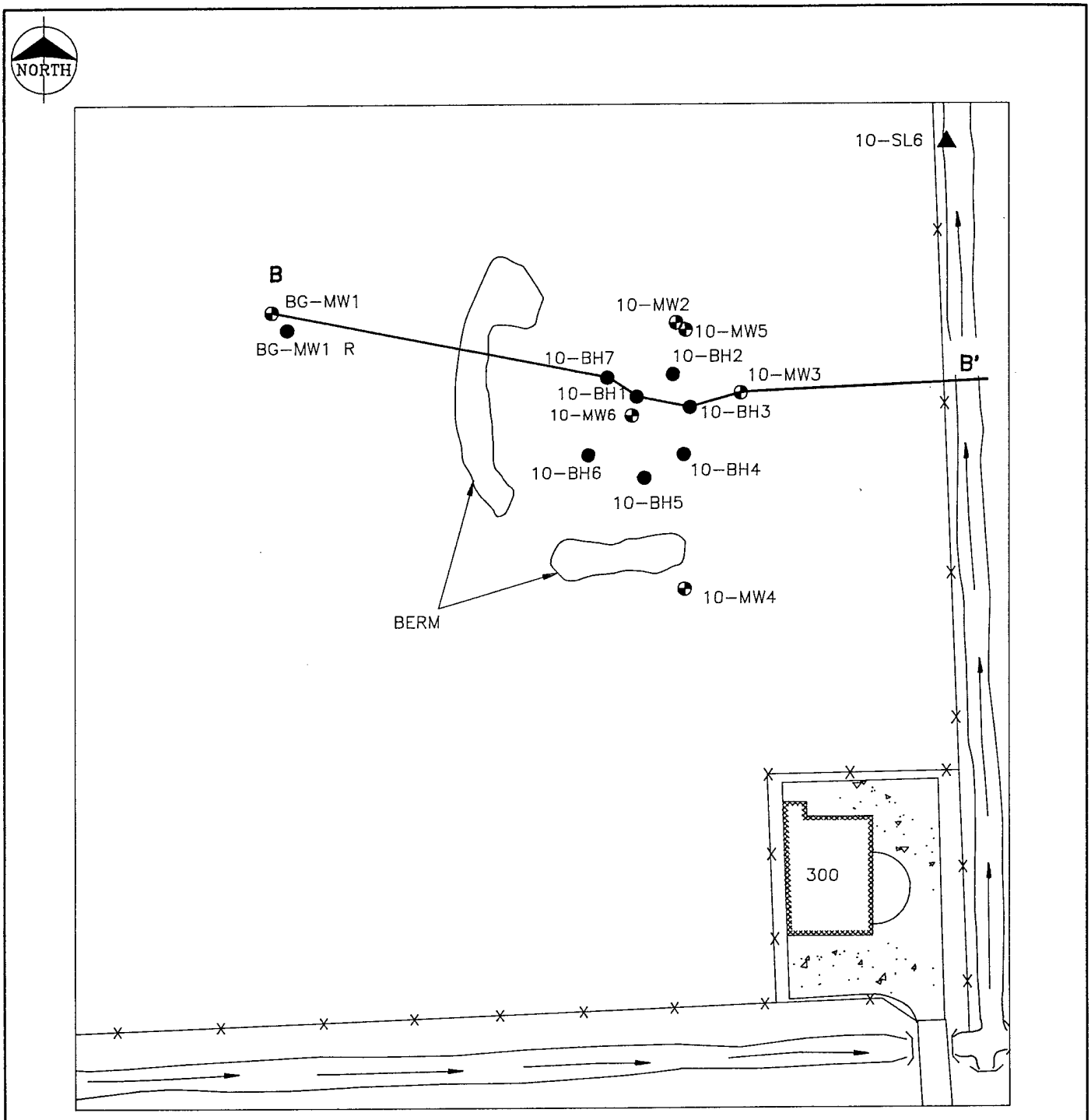
PAVED AREA

GRASSY AREA

10-SL6 ▲ SURFACE WATER SAMPLING LOCATION AND NUMBER

CATION

AGEMENT CONSULTANTS idge, TN 37830 · (615)483-3191	FIGURE 2.4 SITE 10-TOTAL VOLATILE HYDROCARBONS CONCENTRATIONS IN SOIL-GAS AT DEPTHS OF THREE AND SIX FEET NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 1443K09	SCALE: AS INDICATED
		REVISION NO. 1	FILE: ST10HYDR.DWG



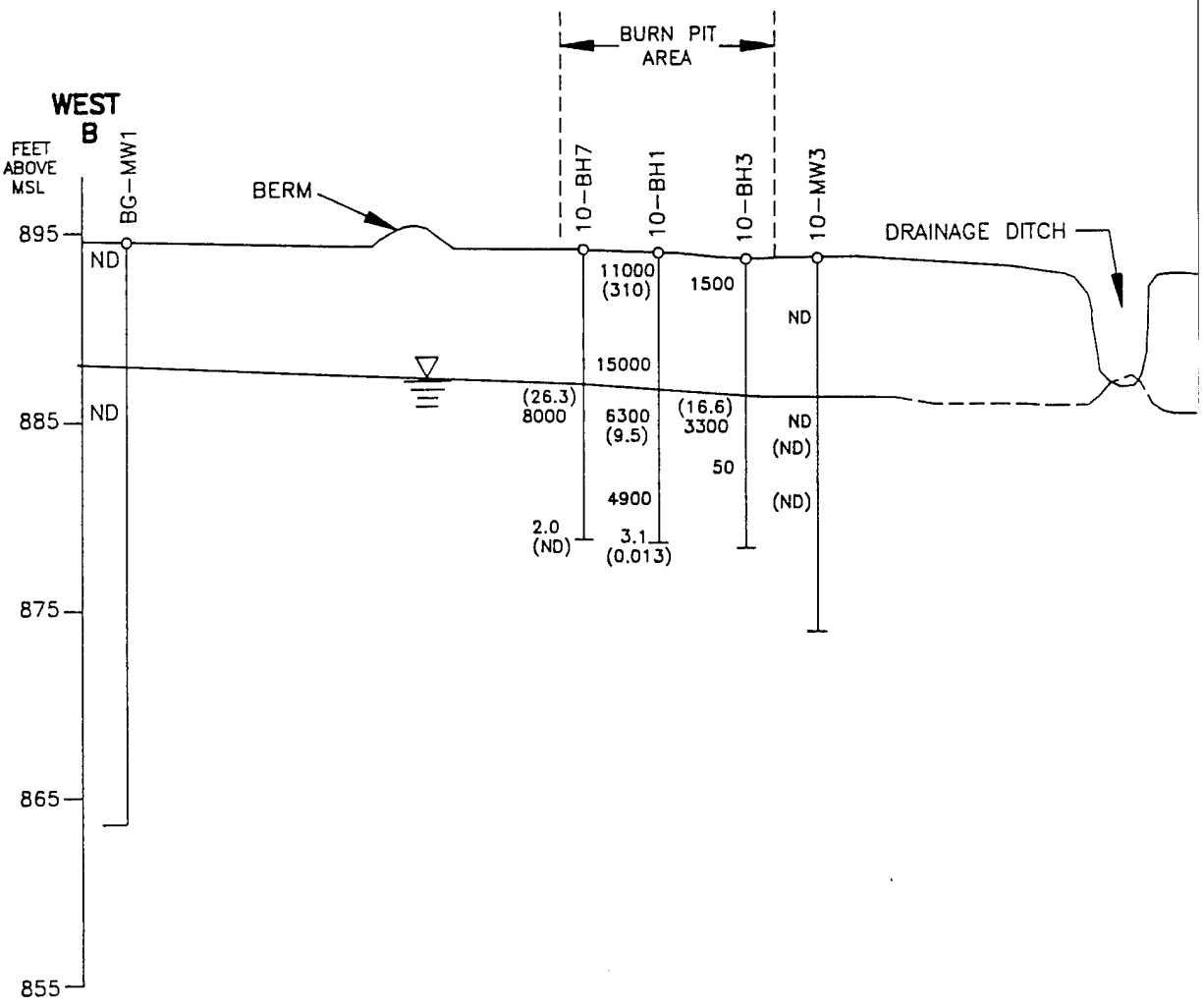
LEGEND:

- 300 — BUILDING AND NUMBER
- PAVED AREA
- GRASSY AREA
- 10–BH7 ● — SOIL BORING
- 10–MW5 ⊕ — MONITORING WELL;
- 10–SL6 ▲ — SURFACE WATER AND SEDIMENT SAMPLING LOCATION
- B ——— B' — LOCATION OF CROSS–SECTION
- ×——× — FENCE
- SURFACE DRAINAGE SHOWING FLOW DIRECTION

0 50 100
SCALE IN FEET

SOURCE: ENGINEERING SCIENCE, INC., 1991

PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 2.5 SITE 10–LOCATION OF SOIL BORINGS AND MONITORING WELLS NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 1443K09	SCALE: AS INDICATED
		REVISION NO. 1	FILE: SITE–10.DWG



SOURCE: ENGINEERING SCIENCE, INC., 1991

0 50 100

HORIZONTAL SCALE IN FEET

PEER
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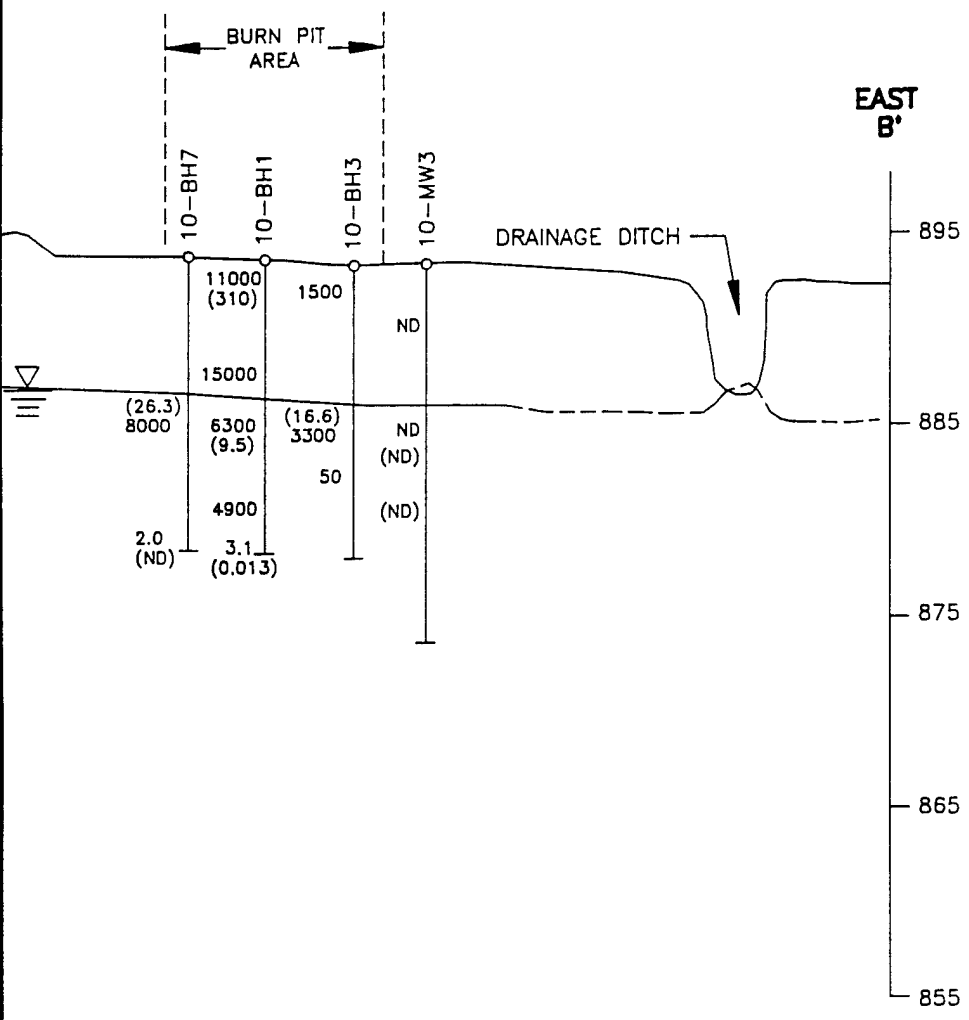
575 Oak Ridge Turnpike ·



LEGEND:

WA

DR
NU
RE
VO
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"N
TH
TH
LA
MI

10-BH7
50
(26.3)

LOCATION OF CROSS
ON FIGURE 2.5

0 50 100

ORIZONTAL SCALE IN FEET

PEER CONSULTANTS, P.C.

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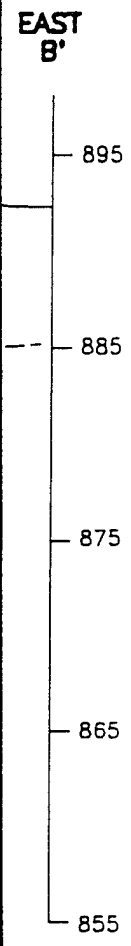
FIGURE 2.6 SITE 10-VERTICAL DISTRI
TOTAL HYDROCARBONS FRO
SOIL HEADSPACE MEASUREMEN
NORTH DAKOTA AIR NATIONAL GU
HECTOR FIELD, FARGO

22



LEGEND:

WATER TABLE, DASHED WHERE INFERRED

10–BH7
(26.3)
50

DRILLING LOCATION AND IDENTIFIER. NUMBERS BESIDE THE BOREHOLE REFER TO THE CONCENTRATION OF TOTAL VOLATILE HYDROCARBONS, IN MICROGRAMS PER LITER OF HEADSPACE. "ND" MEANS NOT DETECTED. THE NUMBER IN PARENTHESIS REFERS TO THE TOTAL BTX CONCENTRATION FROM LABORATORY ANALYSES, IN MILLIGRAMS PER KILOGRAM.

LOCATION OF CROSS–SECTION IS SHOWN ON FIGURE 2.5

MANAGEMENT CONSULTANTS k Ridge, TN 37830 · (615)483–3191	FIGURE 2.6 SITE 10–VERTICAL DISTRIBUTION OF TOTAL HYDROCARBONS FROM SOIL HEADSPACE MEASUREMENTS NORTH DAKOTA AIR NATIONAL GUARD HECTOR FIELD, FARGO	PROJ./DISK: 1443K09	SCALE: AS INDICATED
		REVISION NO. 1	FILE: VER–DIST.DWG

Eleven of the thirteen metals analyzed had concentrations above their respective detection limits; silver and antimony were reported as below their respective detection limits. Eight of the metals were detected at elevated levels in samples collected near the surface. The maximum concentrations in mg/kg were as follows: copper, 1490; lead, 646; zinc, 6660; cadmium, 74.7; beryllium, 1.6; chromium, 215; mercury, 0.58; and selenium, 2.6. Concentrations decreased with depth to near background levels in samples collected below five feet. Concentrations of arsenic, nickel, and thallium were comparable to background values in all samples.

The extract from the TCLP sample contained, in μg/L, toluene, 6; ethylbenzene, 73; xylenes, 57; 2-methylnapthalene, 29; naphthalene, 21; arsenic, 2.6; cadmium, 4.0; nickel, 92; and zinc, 188.

Groundwater

The location of monitoring wells is shown on Figure 2.5. Groundwater samples were collected from the six monitoring wells and submitted for laboratory analysis for volatile and semivolatile organic compounds, thirteen priority pollutant metals and PCBs. Carbon disulfide was detected in two of the wells with the highest concentration of 6 μg/L detected in a sample collected from well 10-MW5. Xylenes were detected at a level of 5 μg/L in a sample from well 10-MW6; however, in a duplicate sample, these were not detected.

The compound, bis(2-ethylhexyl)phthalate was detected in a sample from well 10-MW3 at a level of 7 μg/L. Diethylphthalate was detected at a concentration of 24 μg/L in a sample from well 10-MW5. No other semivolatile organic compounds were detected and no PCBs were detected.

The metals arsenic, copper, nickel, zinc, and cadmium were detected in samples from the wells but at levels comparable to background.

Summary of SI Findings

Contamination detected within the burn pit area included fuel components (benzene, toluene, ethylbenzene, and xylenes) and two chlorinated solvents (trichloroethene and tetrachloroethene). However, volatile organic compounds characteristic of fuels or solvents were not detected in either the soil or groundwater samples collected beyond the edge of the burn pit. This suggests that the areal extent of groundwater contamination is limited to the immediate vicinity of the burn pit. Results from the TCLP indicate that ethylbenzene and xylenes have the potential to be leached from the soil which further suggests that the soil may still be a potential source of groundwater contaminants. No volatile organic compounds were detected in groundwater from downgradient wells and xylenes at a level of 5 μg/L were the only volatile organic compounds detected in groundwater below the site. It should also be noted however,

that during the course of the SI, no samples from Site 10 were submitted for analysis for Total Petroleum Hydrocarbons, for which the state of North Dakota has defined specific regulatory requirements for the closure of petroleum release sites which are described in Section 3.1.1.

Due to the low hydraulic conductivity and the low flow gradients, migration of contaminants in groundwater is not likely. In addition, the massive and almost impermeable clay layer below the site, which is at least 10 ft thick, acts as a barrier to the downward migration of contaminants.

3.0 CORRECTION ACTION OBJECTIVES

3.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The North Dakota regulations regarding USTs are defined in the North Dakota Administrative Code, Title 33 - Department of Health (Chapter 33-24-08), and are no more stringent than the Federal Underground Storage Tank Regulations (40 CFR 280).

3.1.1 Chemical-Specific Requirements

The North Dakota State Department of Health and Consolidated Laboratories (NDSDH&CL) has developed a guidance document titled, "Cleanup Action Level Guidelines for Gasoline and Other Petroleum Hydrocarbons," (Appendix A). These guidelines state that cleanup action levels for soil and groundwater are determined on a site-by-site basis in accordance with criteria established by the Division of Waste Managment and the Division of Water Quality, repectively. In general, however, limits of 5 μg/L for benzene and 500 μg/L for total petroleum hydrocarbons (TPH) in groundwater can be applied. Soils that exceed 100 mg/kg TPH must be removed from the site or treated in place until the TPH level is below 100 mg/kg. In addition, the NDSDH&CL Division of Waste Managment has established a site specific cleanup standard for the sum of benzene, toluene, ethylbenze, and xylenes (BTEX) of 40 mg/kg, with a benzene concentration not to exceed 500 mg/kg (Appendix C).

Excavated soils must be analyzed to determine if they are classified as a characteristic hazardous waste. A waste is a characteristic hazardous waste if it meets any one of the characteristic criteria (40 CFR 261.20): ignitability, corrosivity, reactivity, or toxicity using the TCLP extraction method. If the soil exceeds any of the above criteria, it must regulated and disposed as a hazardous waste.

3.1.2 Location- and Action-Specific Requirements

The NDSDH&CL requires that excavated petroleum contaminated soils be disposed properly or treated. Guidance for treatment or disposal of contaminated soils in North Dakota is contained in the document "Guidelines for Proper Land Treatment of

Petroleum Product Contaminated Soils," (Appendix A). Disposal at a landfill or reuse at an asphalt plant are two methods mentioned in the guidelines. Land treatment may be conducted at existing municipal waste or industrial waste landfills, or may be considered on a case-by-case basis at alternate sites. Treatment of the soil in-place (biodegradation, leaching, or venting) is also acceptable. It should be noted that during the review of the SI Report (ES 1991) that the NDSDH&CL agreed on landfarming the soils on-site at Site 10, and incorporating the soils from Site 2 with those of Site 10.

3.2 CORRECTIVE ACTION SCOPE

This Corrective Action Plan describes the selected corrective action for remediating the contaminated soils from the two sites, including treatment requirements; soil excavation, transport, and placement methods; soil analyses; soil modifications; and monitoring requirements.

4.0 RECOMMENDED CORRECTIVE ACTION

Several options are available in the state of North Dakota for the treatment of petroleum-contaminated soils including:

- landfarming at a state-approved landfill,
- landfarming at a single application site until the TPH concentration is below 10 μg/kg,
- incorporation into asphalt,
- aeration until TPH is below 10 mg/kg and
- in-situ treatment until the TPH is below 100 mg/kg.

Landfarming was chosen as the recommended corrective action due to a cost comparison with the other options, ease of implementation, and its ability to meet treatment objectives. The NDSDH&CL guidelines also seem to favor this treatment option.

Incorporation into asphalt or aeration were not recommended actions because of their high expense. They are also more difficult to implement than landfarming.

In-situ treatment of the soil was not recommended due to difficulty in implementation over the large area of soil contamination. Costs for in situ bioremediation also make this corrective action prohibitive.

The following sections describe the recommended corrective action of landfarming and provides the information required in accordance with the NDSDH&CL guidance document "Application to Land Treat Petroleum Contaminated Soil," (Appendix A).

4.1 INTRODUCTION

The NDSDH&CL generally requires that petroleum-contaminated soils be treated through land application at existing municipal waste or industrial waste landfills although other sites may be considered when landfarming at a landfill is not feasible or is too far away. The requirements are provided in the document, "Land Treatment of Petroleum Contaminated Soil: Single Application Sites," (Appendix A). An application for landfarming must be submitted and approved. Recommended site and soil characteristics as well as recommended land application procedures are also provided in this NDSDH&CL document.

Petroleum contaminated soil has been effectively treated by using land treatment techniques in which petroleum contaminated soil is spread in thin layers to enhance the microbial degradation of the petroleum hydrocarbons. A wide range of naturally-occurring soil bacteria have been demonstrated to use petroleum hydrocarbons as a food source, thereby degrading (i.e. oxidizing) the hydrocarbons into harmless by-products.

The rate of degradation is strongly influenced by a number of environmental factors, including:

- Soil nutrients
- Moisture
- Oxygen
- Temperature
- Microbial population

The degradation process may be enhanced by the addition of specially cultured bacteria and appropriate soil nutrients. Periodic tilling may be used to maintain aerobic conditions.

4.2 DESIGN CONSIDERATIONS

4.2.1 Soil Excavation

It is estimated that approximately 20 yd^3 of contaminated soil will be excavated from Site 2, and 1300 yd^3 from Site 10. Supporting calculations are presented in Appendix B. If possible, the contaminated soil should be excavated between April 1 and November 1, for direct placement into the land farm area. Excavation outside that period will require that the soil be temporarily stockpiled and landfarmed during the NDSDH&CL approved period (April 1 to November 1).

The stockpiled soils must be sampled and tested in accordance with the procedures provided in Part IV of the "Guidelines for the Disposal of Tank Sludge" (Appendix A). Testing includes taking four representative samples to analyze for hazardous waste characteristics. In some cases, if the soils "fail" the Paint Filter Liquids Test, they must be allowed to drain until they can pass the test. The soils may also be mixed with dry, uncontaminated soils to absorb the free liquids. If the soils "fail" the chemical testing, that is, the soil exhibits hazardous characteristics, the soil must be regulated as a hazardous waste and disposed as such.

During soil excavation, groundwater is likely to be encountered between 4 and 7 feet BGS. The contractor performing the excavating work will make provisions for treatment (if necessary) and disposal of the water.

4.2.2 Landfarm Site Preparation

The landfarm for the contaminated soils will require an area of approximately 2.5 acres or 110,000 ft^2 (calculations provided in Appendix B), and two potential locations have been identified by the Base for landfarm. One potential location is near Site 10, and the other, is northeast of Site 10, at a previous landfarm location. During the review of the SI Report (ES 1991), the NDSDH&CL agreed on landfarming the soils at Site 10 on-site, and incorporating the soils from Site 2 with those of Site 10. NDSDH&CL recommended minimum site characteristics include:

- A maximum site slope of 6%;
- A minimum of 100 ft to the nearest surface water;
- A minimum distance of 200 ft to residences or buildings; and
- A minimum depth of 5 ft to the seasonal high water table.

Recommended soil characteristics at the site include:

- slow to moderate permeability (less than 2 inches per hour);
- neutral or slightly alkaline pH (minimum of 6.5);
- moderate to high levels of nutrients;
- well cultivated and fertilized soil; and
- soil moisture content of 50-70 percent of the soil-water holding capacity.

The fertility status of the proposed application site must be evaluated. Eight representative soil samples should be taken (two per acre) and analyzed for organic matter, extractable phosphorus, and pH.

Minimum generally acceptable soil nutrient parameters are as follows:

- Organic matter concentration: 2.0%
- Extractable phosphorus: 20 mg/kg

The NDSDH&CL has recommended fertilizer application rates for soils with nutrients below these levels in their document entitled, "Land Treatment of Petroleum-Contaminated Soil: Single Application Sites" (Appendix A).

The site will be protected from surface water runon by the use of upslope berms to divert water away from the landfarm area. Runoff will be collected by a downstream berm and a containment sump and recirculated as necessary for moisture control. Excess runoff could be discharged to the municipal sewer system. A conceptual drawing of a landfarm area is shown in Figure 3.1.

4.2.3 Landfarming Requirements

The rate of degradation of the petroleum contaminants is influenced by environmental factors such as temperature, soil moisture, oxygen content, soil pH, and available soil nutrients. All of these parameters may be monitored and most may be modified as necessary to optimize the rate of degradation.

The contaminated soil will be transported to the landfarm area and spread in a layer no more than 4-inches thick, per NDSDH&CL guidelines. This corresponds to an application rate of 530 yd^3 per acre. The petroleum loading rate should not exceed approximately 2%, or 20,000 mg/kg total petroleum hydrocarbons as fuel oil or gasoline. The petroleum loading rate will be determined from the laboratory analysis of the soil samples to ensure the loading rate will not exceed these limits. The soil should be spread using a small bulldozer or grader. Appropriate fertilizers should be added to the soil to achieve an optimum carbon:nitrogen:phosphorus:sulfur (C:N:P:S) ratio of 50:2:1:1.

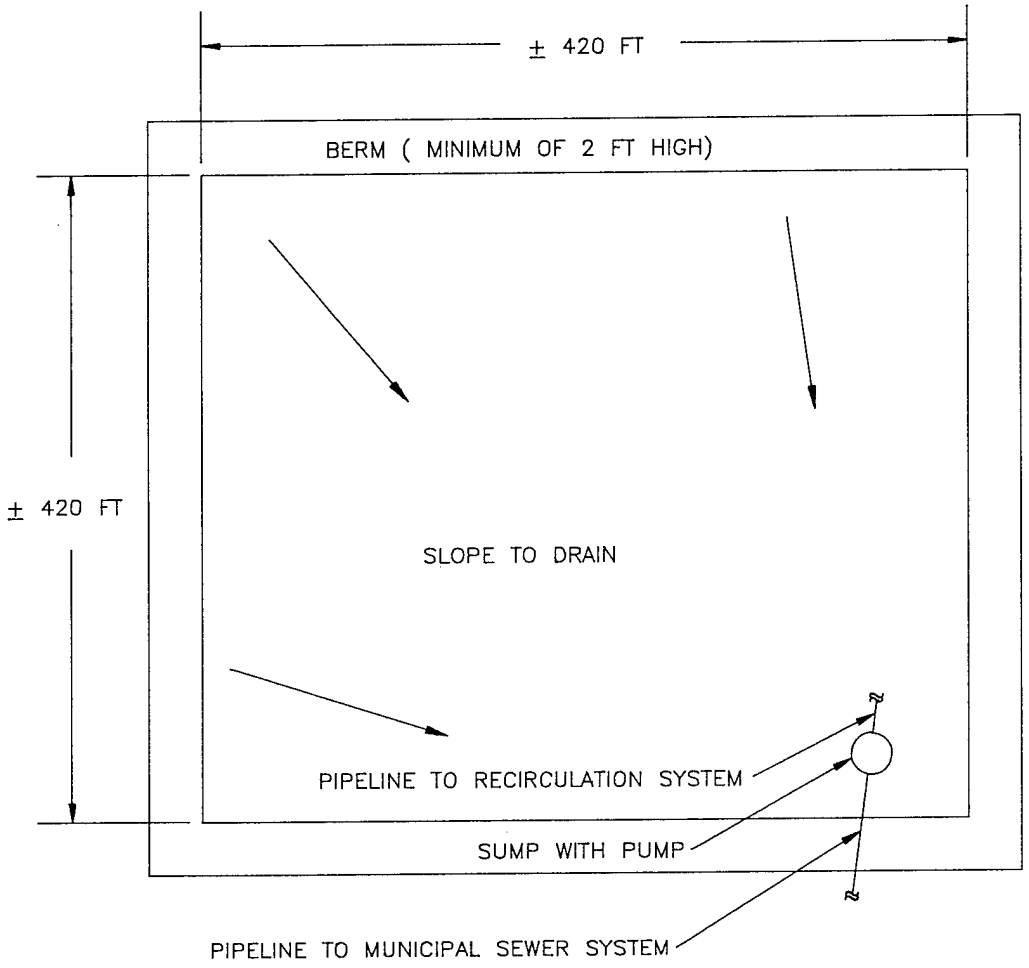
The spread soil should then be mixed (i.e. tilled) with the upper 4 to 6 in of the native soil within 48 hours of application to incorporate the native microbial population, mix the nutrients, and aerate the soils.

Measures to control soil moisture, wind erosion, or the bacterial culture of the soil may be necessary for a successful landfarm operation.

Recirculation of rainfall runoff may aid in increasing soil moisture while more frequent tillage would tend to decrease soil moisture. Incorporation of straw or mulch aids in controlling wind erosion and enhances soil aeration. The addition of organic material such as manure or topsoil will improve soil culture.

4.3 MAINTENANCE AND MONITORING

The soil should be disked monthly during the land application season (April 1 - November 1) to provide adequate mixing and aeration for hydrocarbon breakdown. More frequent tillage could be performed if soil moisture, soil compaction, and wind erosion do not present a problem.



PEER CONSULTANTS, P.C. OAK RIDGE, TN.	FIGURE 3.1 PROPOSED LANDFARM LAYOUT NORTH DAKOTA AIR NATIONAL GUARD BASE HECTOR FIELD, FARGO	PROJ./DISK: 1443K09 LNDFRM-H.DWG	SCALE: NOT TO SCALE
		REVISION NO. 0	DSGN BYP: P. SCHULER DWN BY: C. HALL

For fields where soil is land applied prior to July 1, tillage may not be required in subsequent years. If the soil is spread after July 1, additional tilling beyond the land application period may be required by NDSDH&CL to ensure maintenance of adequate aerobic conditions, unless soil monitoring results are below the required levels.

Follow-up monitoring must be conducted to assess and document hydrocarbon breakdown. The rate of degradation should be monitored on a periodic basis as shown in Table 4.1. In the first year, four samples that represent the entire area must be taken. Soil samples should be taken from a depth of 4-6 in. Samples should be collected and analyzed for TPH as described in the NDSDH&CL "Land Treatment of Petroleum Contaminated Soil: Single Application Sites," (Appendix A), and for benzene and BTEX in accordance with the site-specific standard. Monitoring should continue until levels are below:

- 10 mg/kg TPH,
- 40 mg/kg BTEX, and
- 500 mg/kg benzene.

The NDSDH&CL provides additional guidance for reporting monitoring results and tillage frequency in "Soil Monitoring Results for Land Applied Petroleum-Contaminated Soil," (Appendix A).

4.4 LANDFARM CLOSURE

When the TPH levels in the landfarm soils are below the required regulatory level, the surface water controls and other features may be removed, and a vegetative cover may be developed for the site.

5.0 REFERENCES

Engineering-Science, Inc., "Site Investigation Report," North Dakota Air National Guard Base, Hector International Airport, Fargo, March 1992.

PEER Consultants, P.C., "Draft Closure Assessment Work Plan For Sites 2 and 10," North Dakota Air National Guard Base, Hector Field, Fargo, August 1993.

Table 4.1

Frequency of Landfarm Monitoring
North Dakota Air National Guard Base
Hector Field, Fargo

Land Application Date	Soil Sampling in First Year
Before July 1	Once in August and once in October
July 1 to September 15	Once in October
After September 15	None

Sampling in subsequent years shall include three samples taken in June, August, and October.

APPENDIX A

NORTH DAKOTA STATE DEPARTMENT OF HEALTH AND CONSOLIDATED LABORATORIES
DIVISION OF WASTE MANAGEMENT - UNDERGROUND STORAGE TANK PROGRAM

Cleanup Action Level Guidelines for Gasoline and Other Petroleum Hydrocarbons

This document provides cleanup "action level guidelines" for groundwater, surface water and soil contaminated by a release, spill or overfill of gasoline or other petroleum hydrocarbons from an underground storage tank system. Petroleum underground storage tanks are regulated through the North Dakota Underground Storage Tank (UST) Rules: Chapter 33-24-08 of NDAC Article 33-24.

A petroleum UST system is defined as, "...an underground storage tank system that contains petroleum or a mixture of petroleum with ***de minimus*** quantities of other regulated substances. Such systems include those containing motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, petroleum solvents, and used oils." Under all circumstances, cleanup decisions are made on a site-by-site basis and take into consideration the nature of the release and the site, including the following factors:

1. The location of the site in relation to the surrounding population;
2. The presence of free product;
3. The presence and proximity of municipal utilities;
4. The potential for migration of vapors;
5. The hydrogeology of the site and groundwater use;
6. The use and location of wells potentially affected by the release; and
7. The future site use.

GASOLINE AND OTHER PETROLEUM HYDROCARBON CONTAMINATION

I. Groundwater

Cleanup action levels for groundwater are determined on a site-by-site basis in accordance with criteria established by the Division of Water Quality. In general, however, the following limits can be applied:

Contaminant	Action Level
Benzene	5 ppb (parts per billion)
Total Petroleum Hydrocarbons (TPH)	500 ppb

REV:01/31/92

II. Surface Water

Surface water limits for contamination by gasoline or other petroleum hydrocarbons are established by the Division of Water Quality.

III. Soil and Fill Material

All gasoline contaminated soil and fill material or soil and fill material contaminated by other petroleum hydrocarbons that exceeds a total of 100 parts per million (ppm) TPH as gasoline or fuel oil generally must be removed from the site or treated in-place until the TPH level is below 100 ppm. Treatment or disposal methods should be consistent with the Department's "*Guidelines for Proper Land Treatment of Petroleum Product Contaminated Soils*" or may be handled in any of the methods listed below:

1. Taken to a State-approved landfill for treatment (land-farming). Permission from the owner/operator of the landfill facility is advised before any gasoline contaminated soil or fill is delivered for treatment;

2. Taken to an asphalt plant for reuse in the manufacture of asphalt, contingent on approval by the Division of Environmental Engineering (air quality);

3. Spread on a relatively impermeable material and aerated until the TPH level is below 10 ppm with approval of the Division of Waste Management and local fire and health officials; or

4. Treatment of the soil in-place (biodegradation, leaching, venting, etc.) until the TPH value is less than 100 ppm. If this method is chosen, soil and groundwater samples must be submitted on a regular schedule approved by the Department to monitor progress.

Under certain circumstances, the Division of Waste Management may accept a proposal from the responsible party to leave soil with TPH levels exceeding 100 ppm in-place. Any proposal must provide assurances that concentrations of TPH greater than 100 ppm in the soil will not substantially alter the quality of the environment and that TPH in the contaminated soil will not migrate and contaminate groundwater.

POLICY STATEMENT

The purpose of this policy is to institute contamination cleanup action levels, for petroleum and other petroleum hydrocarbons, that will protect groundwater and the environment. The Division of Water Quality administers the water quality programs in the State of North

Dakota. Cleanup requirements more stringent than those listed in this document may be required by the Division of Water Quality.

This policy sets contamination cleanup action levels that should protect North Dakota's groundwater resource for future use and prevent future groundwater problems through cleanup of contaminated soil. Cleanup of releases from underground storage systems is required by the North Dakota Underground Storage Tank Rules and subject to appropriate enforcement action(s), if deemed necessary.

Once pollution from an UST system has been documented, the Division of Waste Management will require the responsible party (usually the tank owner) to complete an investigation for soil and groundwater cleanup. The investigation must adequately determine the areal and vertical extent of contamination in the soil and groundwater through soil borings and/or installation of groundwater monitoring wells or other techniques approved by the Department. Once the extent of contamination has been determined by the responsible party, a proposal for corrective action may be required. A Corrective Action Plan (CAP) must be submitted for review and approval by the Division of Waste Management and the Division of Water Quality prior to implementation, except as approved by the Department in an emergency situation. All contamination levels must be established using laboratory analytical methods. A list of certified laboratories and recommended sampling and laboratory methods can be obtained from the Division of Waste Management.

Regulatory Agencies

ND State Dept. of Health & Consolidated Laboratories
Div. of Waste Management (701/221-5166)
1200 Missouri Ave., Room 302
PO Box 5520
Bismarck, ND 58502-5520

ND State Dept. of Health & Consolidated Laboratories
Div. of Water Quality (701/221-5210)
1200 Missouri Ave., Room 203
PO Box 5520
Bismarck, ND 58502-5520

ND State Dept. of Health & Consolidated Laboratories
Div. of Environmental Engineering (701/221-5188)
1200 Missouri Ave., Room 304
PO Box 5520
Bismarck, ND 58502-5520

GUIDELINES FOR PROPER LAND TREATMENT OF PETROLEUM PRODUCT CONTAMINATED SOILS

Article 33-20 of the North Dakota Administrative Code regulates the operation and construction of municipal waste landfills, inert waste landfills and industrial waste landfills. In response to numerous requests for guidance and information on proper treatment of petroleum contaminated soils, the Department has prepared these guidelines. Petroleum contaminated soils are not routinely allowed into municipal waste landfills. Any transport, storage or treatment of such materials in regulated landfills or anywhere in the State must be properly coordinated and approved by the Department.

It is important to remember that land treatment activities use unlined surface soils which are subject to direct contaminant losses via air, water or food chain; consequently, facility management has a substantial impact on both the treatment effectiveness and the potential for contamination. Improperly designed or managed land treatment units could cause various types of human health problems or environmental damage. Land treatment relies on volatilization and soil microorganisms to breakdown or "eat" the contaminants. Soil microorganisms, abundant in topsoil, require warmth, nutrients, moisture, and air (tillage) to actively breakdown oil-based contaminants. As appropriate, a culture of microorganisms and nutrients may be added to the soil to facilitate the breakdown processes.

Disposal/Treatment Practices for Petroleum Contaminated Soils

1. Contaminated soils shall be treated only at properly operated, geologically suitable landfills as approved by the Department. (The Department maintains a list of such sites.) At their discretion, owners/operators of landfills can refuse contaminated soil.

2. As little degradation occurs during the cold months, it is prudent to stockpile contaminated soils until the growing season. The stockpile area should be constructed to be as small as practical and to control surface water runoff and run-on.

3. A nearly level to gently sloping area of the landfill where soil will be undisturbed for several months should be selected. This can be a reclaimed area, closed area, or area yet to be landfilled. Soils need to be clayey with a topsoil layer present or topsoil added.

4. Surface water controls are necessary around storage and treatment areas. These controls must be adequate to control

runoff/run-on at the site. Ditches or berms upslope of the site should divert water inflow around and away from the treatment area. Berms, ditches, or impoundments downslope at the site must be adequate to contain and store surface water runoff during heavy precipitation events. Surface water runoff must not be allowed to cause degradation of any off-site streams, rivers, lakes, etc.

5. Prepare the treatment area by tilling to a depth of six inches. Additional nutrients (fertilizer) may be required for efficient degradation. Manure can be used. Manure provides nitrogen and organic matter which enhances absorption of the waste constituents. The soil should be tested to determine any fertilizer needs.

6. Contaminated soils should be spread in a uniform layer no thicker than six inches over the area and then tilled into the prepared surface.

7. The disposal facility should plan on allowing at least a 45-day residence time for the soil to be treated at the site. Factors modifying the treatment time period are: season, soil temperature, soil fertility, soil moisture, amount of tilling, degree of contamination, and waste characteristics. Maintaining soil moisture near field capacity is important. The treatment area may require daily irrigation during dry weather.

8. The material should be tilled, at a minimum, once every two weeks until any noticeable odor is no longer present.

9. Properly landfarmed materials may be included in a stockpile for use as final cover for closed portions of the landfill site or the area could be left in place and planted to grass to control erosion.

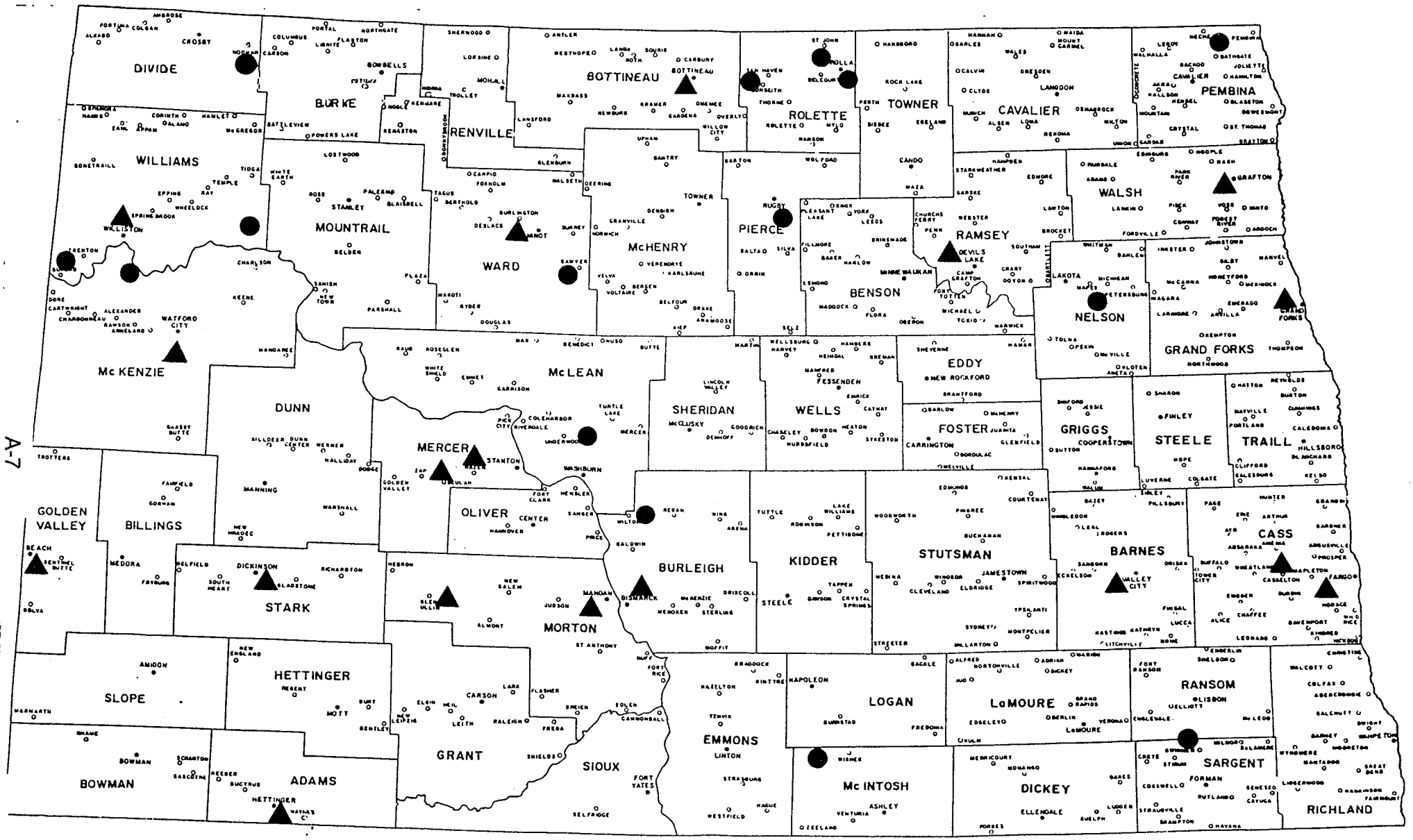
10. Quantities of 20 cubic yards or less containing no free liquids, received in a four week period, that can be spread to less than 1/2-inch thickness may be landspread without tillage. Cumulative quantities in excess of this amount received in the aforementioned time period will be handled as instructed by steps 1-9.

SUITABLE LANDFILL FACILITIES FOR THE TREATMENT OF PETROLEUM PRODUCT CONTAMINATED SOILS

MUNICIPAL WASTE DISPOSAL FACILITIES

PERMIT	NAME	ADDRESS	CITY	STATE	ZIP	COMMENTS
SW-319	ADAMS COUNTY LANDFILL	PO BOX 589	HETTINGER	ND	58639	701-567-2468
SW-329	BAUER, ROBERT	PO BOX 98	WILTON	ND	58579	701-734-8186
SW-013	BEACH	PO BOX 278	BEACH	ND	58621	701-872-4103
SW-276	BEULAH	PO BOX 910	BEULAH	ND	58523-0910	701-873-4637
SW-257	BIG DIPPER	PO BOX 626	WAHPETON	ND	58075	701-642-8920
SW-017	BISMARCK	PO BOX 5503	BISMARCK	ND	58502	701-222-6431
SW-281	BOTTINEAU	115 WEST 6TH ST	BOTTINEAU	ND	58318	701-228-3232
SW-317	CASSELTON (NEW SITE)	PO BOX 548	CASSELTON	ND	58012-0548	701-347-4861
SW-044	DEVILS LAKE	PO BOX 1048	DEVILS LAKE	ND	58301-1048	701-662-4098
SW-315	DICKINSON	PO BOX 1037	DICKINSON	ND	58601-1037	701-264-7746
SW-260	FARGO - RON OLSON, GARBAGE UTILITY	2301 8TH AVE N	FARGO	ND	58102	701-241-2489
SW-065	GLEN ULLIN	PO BOX 70	GLEN ULLIN	ND	58631-0070	701-348-3683
SW-068	GRAFTON	PO BOX 578	GRAFTON	ND	58237	701-352-1561
SW-069	GRAND FORKS	PO BOX 1518	GRAND FORKS	ND	58201	701-775-8103
SW-270	HAZEN	PO BOX 717	HAZEN	ND	58545-0717	701-748-2250
SW-332	JAHNER SANITATION, INC.	PO BOX 397	LINTON	ND	58522	701-254-4533
SW-324	JENSON, HAROLD JR		NECHE	ND	58265	701-886-7440
SW-285	MANDAN (NEW SITE)	203 2ND AVE NW	MANDAN	ND	58554	701-667-3218
SW-326	MCDANIEL LANDFILL	PO BOX 1793	MINOT	ND	58702	701-839-2958
SW-272	MINOT	CIVIC CENTER	MINOT	ND	58701	701-857-4140
SW-333	MISSOURI RIVER SANITATION	PO BOX 1145	WASHBURN	ND	58577	701-462-3740
SW-251	MURPHY SERVICE	PO BOX 104-A, RT 1	ROLLA	ND	58367	701-477-3447
SW-280	MURPHY SERVICE - MURPHY/COLEMAN SITE	PO BOX 104-A, RT 1	ROLLA	ND	58367	701-477-3447
SW-271	MURPHY SERVICE - TURTLE MOUNTAINS SITE	PO BOX 104-A, RT 1	ROLLA	ND	58367	701-477-3447
SW-107	NELSON COUNTY	COURTHOUSE	LAKOTA	ND	58344	701-247-2463
SW-237	NORTHWEST SOLID WASTE MANAGEMENT COUNCIL C/O DICK ROSS	BOX 67	RAY	ND	58849	701-568-2204
SW-144	VALLEY CITY	PO BOX 390	VALLEY CITY	ND	58072-0390	701-845-1700
SW-309	VOLK, CASPER	307 2ND ST SE	RUGBY	ND	58368	
SW-152	WATFORD CITY	PO BOX 494	WATFORD CITY	ND	58854-0494	701-842-2533
SW-303	WILLISTON (NEW SITE)	PO BOX 2437	WILLISTON	ND	58802	
SU-079	DISHON DISPOSAL	ROUTE 3, BOX 64	WILLISTON	ND	58801	
SU-088	HEXOM CONSTRUCTION	ROUTE 3, BOX 238	WILLISTON	ND	58801	
SU-063	PRAIRIE DISPOSAL	1109 2ND AVE E	WILLISTON	ND	58801	

*AT THEIR DISCRETION, OWNERS/OPERATORS OF LANDFILLS MAY REFUSE CONTAMINATED SOIL



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DISPOSAL SITES APPROVED FOR ACCEPTING PETROLEUM-CONTAMINATED SOILS

▲ MUNICIPAL FACILITIES

● PRIVATE FACILITIES

NORTH DAKOTA
STATE DEPARTMENT OF HEALTH
AND CONSOLIDATED LABORATORIES

ENVIRONMENTAL HEALTH SECTION

1200 Missouri Avenue
P.O. Box 5520
Bismarck, North Dakota 58502-5520
Fax #701-221-5200

LAND TREATMENT OF PETROLEUM CONTAMINATED SOIL: SINGLE APPLICATION SITES

The North Dakota State Department of Health and Consolidated Laboratories (NDSDHCL) requires that excavated petroleum contaminated soil be treated or disposed of properly. Incorporation of petroleum contaminated soil into the top six inches of native soil can be an effective treatment option. Land treatment of wastes must be approached on a scientific basis and should not be considered as a "black box" for disposal of wastes. Land treatment takes advantage of naturally occurring soil microorganisms to biodegrade petroleum. Some volatilization of petroleum hydrocarbons will also occur during the process.

The Department has generally required that petroleum contaminated soil be treated through land application at existing municipal waste or industrial waste landfills. On a case-by-case basis, the Department will consider allowing treatment at other sites when landfarming at a landfill is not feasible or is too far away. This document outlines suitable site and soil characteristics, land application procedures, soil sampling requirements and necessary approval requirements for sites receiving a single, one-time application of petroleum contaminated soil. On a case-by-case basis, depending on the site capabilities and the waste material, the Department may allow two or three site applications on discrete areas of a single application site; however, appropriate documentation must be provided as outlined herein. Except as provided under this variance, sites in which repeated applications of petroleum contaminated soil are proposed must meet additional conditions.

A form entitled "Application to Land Treat Petroleum Contaminated Soil" is attached and should be completed and submitted to Departmental staff for approval prior to land application at single application sites and approved facilities.

I. BACKGROUND INFORMATION

The following list outlines the minimum information which should be provided to the Department (NDSDHCL) along with the application prior to approval of a proposed site for land application of petroleum contaminated soil.

A. Disposal site location and site location map.
B. Landowner's name, address and telephone number.

Environmental Health Section and Enforcement 701-221-5150 | Environmental Engineering 701-221-5188 | Municipal Facilities 701-221-5210 | Waste Management 701-221-5166 | Water Quality 701-221-5210

C. Documentation of approval or notification (providing a reasonable time for response) of the appropriate local officials (county, city, or township).
D. Topographic and soil survey maps with the proposed spreading site outlined and a map scale presented.
E. Estimated volume of soil to be landspread.
F. Projected date of spreading.
G. Site and soil characteristics (see below).
H. Proposed land application procedures (see below).
I. Proposed sampling, tillage and reporting schedule (see below).
J. Any previous history of waste disposal activities at the proposed site.
K. Site visit by a qualified environmental consultant.

II. SITE AND SOIL CHARACTERISTICS

This section outlines the recommended site and soil characteristics which should be used to evaluate a site's suitability as a land application site. Exceptions to these criteria may be made by the Department on a site-specific basis. Published soil survey information (available through county Soil Conservation Service offices) provides an excellent reference for some of the necessary site characteristics such as site slope, depth to groundwater, and soil type for most native soils in North Dakota. If specific soil information is not available or if more detailed soil information is required, a Professional Soil Classifier can be utilized to determine site-specific soil conditions. Soil borings or trenching, or a hydrogeologic evaluation, may be required to evaluate the proposed land application site.

Note: Unsuitable land application sites include closed fill areas of former waste disposal sites (e.g., landfills), gravel pits, quarries, and 10-year floodplains. Areas with highly permeable soils or areas that are excessively steep should also not be considered.

A. Site slope: 6 percent maximum.
B. Minimum distance to surface water: 100 feet.
C. Minimum distance to residences or buildings: site specific, in general 200 feet.
D. Minimum depth of 5 feet to seasonal high water table for most soils.
E. Soil characteristics:

1. Permeability: slow to moderate, less than 2 inches per hour. Areas underlain by highly permeable soils, very slowly permeable soils, or sodium affected soils should be avoided.

2. pH: minimum pH of 6.5, neutral or slightly alkaline preferred.

3. Nutrients: soils with moderate to high levels of fertility are preferred.

4. Well cultivated and fertilized fields are desirable.

5. Optimum soil moisture content is 50-70 percent of the soil water holding capacity.

Soil nutrient tests and/or fertilizer addition should be completed for fields with low fertility (e.g., low organic matter, eroded, or disturbed soils) and/or depending on the contamination level of the soils and the thickness the soil is to be spread. Information on soil organic matter content provides a general indicator of both soil nitrogen and sulfur supply. Extractable phosphorus indicates soil phosphorus supply. Minimum generally acceptable levels for these parameters are:

- Organic matter concentration: 2.0 percent
- Extractable phosphorus: 20 milligrams per kilogram

For soil analysis results below these levels, nutrients should be applied in accordance with the following table:

Soil Contaminant Concentration	Pounds/Acre Fertilizer to Apply		
	Nitrogen	Sulfur	Phosphorus (P_2O_5)
1000 ppm Total Hydrocarbons	30	20	40
2000 ppm Total Hydrocarbons	60	40	80
3000 ppm Total Hydrocarbons	90	60	120
4000 ppm Total Hydrocarbons (or greater)	120	80	120

NOTE: Table assumes 4-inch spreading thickness; reduce rates accordingly for lower spreading thicknesses. Fertilizer rates should not exceed 120 pounds nitrogen/acre, 80 pounds sulfur/acre, and 120 pounds P_2O_5/acre.

III. LAND APPLICATION PROCEDURES

Acceptable procedures for land application are outlined below. The Department will consider exceptions on a site-specific basis.

A. Contaminated soil should be spread only when the land is tillable, but no earlier than April 1 and no later than November 1. If contaminated soil is to be stockpiled, it should be in an area where surface water run-on and runoff is controlled.

B. As appropriate, surface water controls must be utilized around storage and treatment areas so that water run-on and runoff is controlled. Surface water runoff must not be allowed to cause degradation of any off-site streams, rivers, wetlands, lakes, etc. Ditches and berms upslope of the site should divert water inflow around and away

from the treatment area. Berms, ditches, or impoundments downslope of the site may be necessary to contain and store any contaminated runoff during heavy precipitation events.

C. Contaminated soil cannot be applied greater than 4 inches in thickness. The Department may require thinner spreading thicknesses on a site-specific basis. Corresponding soil application rates for suitable spreading thicknesses are as follows:

1. 530 cubic yards/acre at 4-inch spreading thickness
2. 400 cubic yards/acre at 3-inch spreading thickness
3. 270 cubic yards/acre at 2-inch spreading thickness
4. 135 cubic yards/acre at 1-inch spreading thickness

(1 cubic yard = 27 cubic feet, 1 acre = 43,560 sq. ft.)

The petroleum loading rate should not exceed approximately 2 percent or 20,000 parts per million (ppm) total petroleum hydrocarbons as fuel oil or gasoline in the soil to be land applied. This corresponds to approximately 67 barrels (2800) gallons per acre for soil spread 4 inches thick contaminated with a relatively heavy oil.

D. The method of spreading the contaminated soil (dozer, grader, spreader, etc.) should be specified.

E. Land applied soil should be incorporated (mixed) with the upper 4 to 6 inches of native soil within 48 hours after application. Fertilizers should be broadcast either just before or just after soil spreading, but prior to incorporation. Nutrients should be added as necessary to maintain an optimum C:N:P:S ratio of 50:2:1:1.

F. To enhance hydrocarbon breakdown, the soil should be disked monthly during the land application season. Less frequent tillage may not provide adequate aeration and mixing and, therefore, may slow hydrocarbon breakdown. More frequent tillage could be done if soil moisture is adequate, soil compaction is not a problem, and wind erosion can be controlled.

For fields where petroleum contaminated soil is land applied prior to July 1, tillage may not be required in subsequent years. However, soil monitoring shall continue until contamination is below acceptable levels, as outlined in Part IV.C. For land applications after July 1, a minimum of six monthly tillage operations will be required (excluding the period from November 1 to April 1), unless soil monitoring results are below the acceptable levels (Part IV.C).

G. Depending on site conditions, the operation, climatic conditions and other factors, measures to control soil

moisture and wind erosion as well as to improve the bacterial culture of the soil may be needed. If the soils are excessively dry, the addition of moisture to the site may be necessary (ponded surface runoff water could be used). More frequent tillage or site drainage may be necessary if the site is too wet. The incorporation of straw or mulch is advised to help control wind erosion and improve soil aeration. If the soil is deficient in humus (organic material) and/or oil degrading soil bacteria, the addition of innoculants, rotted manure, mature compost, or rich topsoil is advised.

IV. SOIL SAMPLING REQUIREMENTS

A. Contaminated stockpiled soil: Soil samples must be taken to evaluate and document the contamination levels in the soil to be treated. Soil samples should be composite samples. Dig a minimum of 1 foot into the pile at least three places within the pile before collecting the samples. To avoid cross-contamination, samples should be taken using clean disposable gloves (and other clean sampling utensils) at each sample location [refer to NDSDHCL "Procedures for Collection of Soil Samples at UST Sites"]. Mix equal portions of each sample before sealing the sample container. Completely fill each sample vial so that no headspace exists, wipe soil from the vial threads, and seal the vial using a cap with a teflon septum. Label the vial, wrap it in aluminum foil, and place in a covered cooler with ice for transport to a laboratory for analysis.

The number of soil samples should be based on the following table:

Volume of Soil (cubic yards)	Number of Samples
<10	0
10-50	1
50-500	2
500-1000	3
1000-2000	4
2000-4000	5
Each additional 2000	One additional sample

Soil samples should be analyzed for total petroleum hydrocarbons as fuel oil or gasoline, lead (for leaded gasoline or any lead-bearing petroleum hydrocarbon, required once per sample prior to application) and pH. Other analysis such as benzene, ethyl benzene, toluene and xylenes may be necessary depending on site conditions or depending upon the product involved.

B. Land application site soil nutrient level determination: If the fertility status of the proposed land application site must be evaluated (see Part II), several representative soil samples from the top six inches of native soil should be taken. These samples should be handled and prepared for analysis in accordance with the procedures recommended by the soil testing laboratory to be used.

Samples should be analyzed for organic matter (using loss on ignition methodology), extractable phosphorus (Bray-1 method for soil pH 7.4 or less; Olsen's phosphorus method for soil pH greater than 7.4), and soil pH (to determine appropriate phosphorus method).

C. Follow-up monitoring: To assess and document hydrocarbon breakdown, follow-up soil samples must be taken. These samples should be taken from a depth of 4-6 inches (using the sampling methods discussed in Part IV.A above). The number of grab samples to be taken at each sampling interval should follow the table in Part IV.A and should adequately represent the entire land treatment area. Samples need only be analyzed for total petroleum hydrocarbons; however, the Department may require sampling for additional constituents under some circumstances.

During the year of land application, samples shall be taken at the times specified below until soil analytical results are 10 ppm total petroleum hydrocarbons or less.

Land Application Date	Soil Sampling in 1st Year
Before July 1	Once in August & once in October
July 1 to September 15	Once in October
After September 15	None

Sampling in subsequent treatment years shall include three samples taken approximately in June, August and October, unless results are below 10 ppm total petroleum hydrocarbons.

Refer to the document "Soil Monitoring Results for Land-Applied Petroleum Contaminated Soil" for reporting results.

V. SUBMITTAL AND APPROVAL PROCESS

The attached form "Application to Land Apply Petroleum Contaminated Soil" should be completed and submitted with the required maps, diagrams and information to the Department. Arrangements should be made with appropriate Departmental staff for a site inspection. The site inspection will be done by either Departmental staff, by an individual authorized by the Department (e.g., some local government officials), or by a qualified environmental consultant whose evaluation is subject to Departmental review and approval. If approved, the inspector will sign and date the application form. On a site-specific basis, a site inspection may not be required.

APPLICATION TO LAND TREAT PETROLEUM CONTAMINATED SOIL

Please refer to the Departmental guideline document "Land Treatment of Petroleum Contaminated Soil: Single Application Sites" for specific information on acceptable soil and site criteria.

I. BACKGROUND INFORMATION

A. Tank owner/operator mailing address: _____

_____

Contact: _____
Company name: _____
Street/Box: _____
City, Zip: _____
Telephone: _____

B. Site from which contaminated soil originated: _____

_____

Company name: _____
Street: _____
City, Zip: _____
County: _____

C. Address or legal description of land spreading site: _____

_____

Contact: _____
Street: _____
City, Zip: _____
Telephone: _____

_____ 1/4 of _____ 1/4 of Section _____, Township _____, Range _____ Township Name _____

D. Consultant (or other) preparing this form: _____

_____

Contact: _____
Company name: _____
Street/Box: _____
City, Zip: _____
Telephone: _____

E. Facility ID number: _____ (FOR STATE USE ONLY)
F. Estimated volume of soil to be land applied (cu.yds.): _____
G. Projected date of application of soil: _____
H. Have there been past waste disposal activities at the proposed site? No ☐ Yes ☐, please explain: _____

II. SITE AND SOIL CHARACTERISTICS

A. Site slope (percent): _____
B. Distance to surface water (feet or miles): _____
C. Distance to nearest building or residence (feet): _____
D. Depth to seasonal high water table (feet): _____
Depth to field tile lines (feet): _____
If bedrock exists at 8 feet or less, indicate depth (ft.) _____
E. Area of land to be used (square feet or acres): _____
F. Spreading thickness (inches): _____

III. SOIL SAMPLING RESULTS

A. If soil nutrient tests were conducted, list the results below:

Sample Number	Organic Matter (Percent)	Extractable Phosphorus (ppm)
_____	_____	_____
_____	_____	_____
_____	_____	_____

If fertilizers will be applied, provide application rates:

___lbs. nitrogen/acre; ___lbs. P_2O_5/acre; ____lbs. sulfur/acre

B. Check the type(s) of petroleum contamination:

Unleaded gas ☐ No. 2 fuel oil ☐
Regular gas ☐ Waste oil ☐
Diesel fuel ☐ Other (please specify): _____

List the appropriate soil sample analytical results from the excavated contaminated soil (refer to the Departmental document "Land Treatement of Petroleum Contaminated Soil: Single Application Sites"). If the petroleum was not gasoline or fuel oil, attach a separate table.

		Waste/Used Oil Contaminated Soils				
Sample Number	TPH as gas or FO (ppm)	Benzene (ppm)	Chromium (ppm)	Lead (ppm)	TOX (ppm)	Ignitability (free liquids)
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

IV. FIGURES

Include the following figures:

A. Copy of county soil survey map (if the county has been mapped) or other appropriate soil details with copies of the interpretation sheets.
B. Site location map with exact application location marked (scale should be approximately 1 inch = 50 feet).

****

Signature and title of staff inspector (or other authorized inspector: _____ Date inspected: _____

Signature and title of county official: _____

Signature and title of city/township official: _____

****

Mail to: ND State Dept. of Health & Consolidated Laboratories
Waste Management Division
1200 Missouri Ave. - PO Box 5520
Bismarck, ND 58502-5520

SOIL MONITORING RESULTS FOR LAND-TREATED PETROLEUM CONTAMINATED SOIL

This form should be used for reporting the results of follow-up soil sampling where petroleum contaminated soil has been land applied. Refer to the North Dakota State Department of Health and Consolidated Laboratories' document "Land Treatment of Petroleum Contaminated Soil: Single Application Sites" for specific information on soil sampling.

A. Tank owner/operator: _____

Petroleum release site: _____

Facility ID number: _____ (FOR STATE USE ONLY)

B. Address or legal description of land application site:

Street: _____ City: _____

___ 1/4 of ____ 1/4 of Section ____, Township ____, Range ____

C. Consultant (or other) preparing this form: _____

Contact: _____ Phone: _____

D. Dates that tillage was done (since land application or the most recent monitoring report): _____ _____ _____

Address: _____ City: _____ Phone: _____

Name of operator or firm responsible for tillage: _____

_____

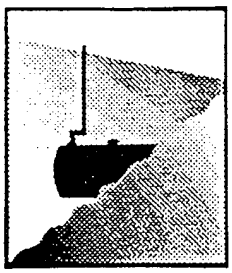
Soil sampling date: _____

List the soil sample analytical results from the land application site. Use parts per million (ppm) units.

Sample Number	Total Hydrocarbons as Gas or Fuel Oil (ppm)	Sample Number	Total Hydrocarbons as Gas or Fuel Oil (ppm)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

NOTE: ATTACH COPIES OF LABORATORY RESULTS & CHAIN OF CUSTODY FORMS

Mail to: ND State Dept. of Health & Consolidated Laboratories
Div. of Waste Management
1200 Missouri Ave. - PO Box 5520
Bismarck, ND 58502-5520



PROCEDURES FOR THE COLLECTION OF SOIL SAMPLES AT UST SITES

This document provides general guidance for the collection of soil samples contaminated by gasoline or other petroleum hydrocarbons at underground storage tank sites. Petroleum underground storage tanks are regulated by the North Dakota Underground Storage Tank (UST) Rules-Chapter 33-24-08 of NDAC Article 33-24.

I. GENERAL PROCEDURES

The locations of surface soil samples, soil borings, and excavation areas should be identified and documented on a site map. Soil boring logs should be prepared by qualified personnel (e.g. geologist, engineer etc.) and be included along with the site map, in a Site Investigation Report. The appropriate method for obtaining a soil sample is determined by site conditions. Soil samples can be obtained using the following methods:

* hand auger, trowel or spatula for collecting surface samples and composite samples of stockpiled soils;
* split spoon sampler when drilling well boreholes and constructing depth profiles; and
* backhoe for collecting samples from the UST excavation area.

II. SURFACE SAMPLING

All soil sampling equipment must be decontaminated prior to each use. A shovel, trowel or scoop can be used for sample collection of surface soils. Soil samples taken at depths greater than 3 inches should be collected with a hand auger or a tube sampler. Stainless steel sampling equipment should be used whenever possible.

III. SUBSURFACE SAMPLING

Borings for subsurface sampling should be advanced with a hollow-stem, continuous flight auger. Other drilling methods may be used as dictated by site specific conditions and approved in advance by the North Dakota State Department of Health and Consolidated Laboratories.

Soil samples should be obtained using a split spoon sampler. The sampling method as prescribed by ASTM:D 1586-84 may be used. Samples should, at a minimum, be taken every five feet or as often as necessary to accurately describe the stratigraphy and any zones of contamination. The sampling device should be decontaminated between each sampling event.

IV. SOIL SAMPLES

The labels on the soil sample containers should indicate the following:

* Type of analysis;
* Name of facility;

* Sampling point identification;
* Name of person collecting the sample; and
* Time and date the sample was collected.

Chain of custody tracking must be done for all samples. Chain of custody provides a record of all the personnel responsible for handling the samples. A log should be kept of all sampling activities.

REGULATORY AGENCY

North Dakota State Department of Health
& Consolidated Laboratories
Division of Waste Management
1200 Missouri Avenue
P.O. Box 5520
Bismarck, North Dakota 58502-5520

North Dakota State Department of Health and Consolidated Laboratories
Division of Waste Management

GUIDELINES FOR THE DISPOSAL OF TANK SLUDGE

Underground Storage Tank (UST) Wastes

This document provides guidelines for the disposal of wastes which are generated from the cleaning of underground storage tanks. It is intended to provide the necessary information to tank owners and tank removal contractors so that each type of waste is tested, treated and disposed in accordance with the North Dakota Underground Storage Tank Rules, Hazardous Waste Management Rules and Solid Waste Management Rules.

Please note that the wastes from USTs may be classified as regulated hazardous wastes if these wastes exhibit certain characteristics. These characteristics are discussed in the following sections of this document. If, after testing these wastes, they are determined to meet the criteria of a characteristic hazardous waste, they must be stored, handled and disposed in accordance with the North Dakota Hazardous Waste Management Rules. For information regarding these Rules contact the Division of Waste Management - Hazardous Waste Program (701-221-5166).

Petroleum USTs (Gasoline, Diesel and Fuel Oil Products)

I. Petroleum product.

Usable petroleum products should be removed from the USTs and sold or reused as products.

II. Petroleum tanks (USTs).

A. All USTs which are excavated or closed in-place must be empty and cleaned by removing all liquids and accumulated sludges. NOTE: the following cleaning and closure procedures may be used to comply with this requirement.

1. American Petroleum Institute Recommended Practice 1604, "Removal and Disposal of Used Underground Petroleum Storage Tanks;"

2. American Petroleum Institute Publication 2015, "Cleaning Petroleum Storage Tanks;"

3. American Petroleum Institute Recommended Practice 1631, "Interior Lining of Underground Storage Tanks" may be used as guidance for compliance with this requirement; and

4. The National Institute for Occupational Safety and Health "Criteria for a Recommended Standard***Working in Confined Space" may be used as guidance for conducting safe closure procedures at some hazardous substance tanks.

B. All USTs which are excavated or closed in-place should be "opened" in a manner as specified in the above referenced industry codes and recommended practices. If an excavated tank is to be used for private, noncommercial above ground storage of a petroleum product, the UST

owner/operator should contact the State Fire Marshal's Office (701-224-2434) for recommendations on proper installation and siting.

CAUTION: Under no circumstances should tanks which previously contained leaded gasoline be used for the subsequent storage of foods or liquids intended for animal or human consumption.

C. Once opened, all sludge, scale and waste product must be removed from the UST and accumulated in a tank or container which is in compliance with the North Dakota Hazardous Waste Management Rules. A 55-gallon drum in good condition may meet the definition of a container (see the section below regarding "Wastes Contained in Petroleum USTs").

D. It is recommended that all USTs be thoroughly cleaned using a suitable cleaning device such as a high pressure steam cleaner. The rinsate generated by this step can be containerized or passed through an oil-water separator. The water from the separator can be discharged to a municipal sanitary sewer or directly to a municipal waste treatment pond after obtaining permission from the appropriate state and/or local official(s).

E. If the UST is to be disposed of, it must be cut into pieces of a size approved by the landfill operator who has agreed to accept the waste steel. Permission from the owner/operator of the landfill is advised before an UST is delivered for disposal. As an alternative to disposal, steel tanks may be sold as scrap following proper cleaning and decontamination.

III. Wastes contained in petroleum USTs (see Charts 1 and 2).

A. All sludge, scale, waste product and rinsate generated as a result of cleaning the inside of petroleum USTs must be containerized separately in 55-gallon steel drums at the cleaning site. Each drum should be filled not more than one-third (1/3) full and be properly identified and/or labeled. Any rinsate from washing the tank may be discharged in the manner as described in Section II.D, above.

B. If the <u>total</u> amount of the petroleum UST waste is GREATER than 220 lbs. (approximately 22 gallons - see Chart 2), samples must be taken from each waste type (sludge, scale, waste product and rinsate) and either combined into a single composite sample and analyzed or analyzed separately by the following chemical testing procedure:

Table 1.
Petroleum USTs - Testing Procedure

Characteristic	Regulatory Limit
Benzene*	0.5 mg/l
Lead*	5.0 mg/l
Flash point (free liquids)	140°F

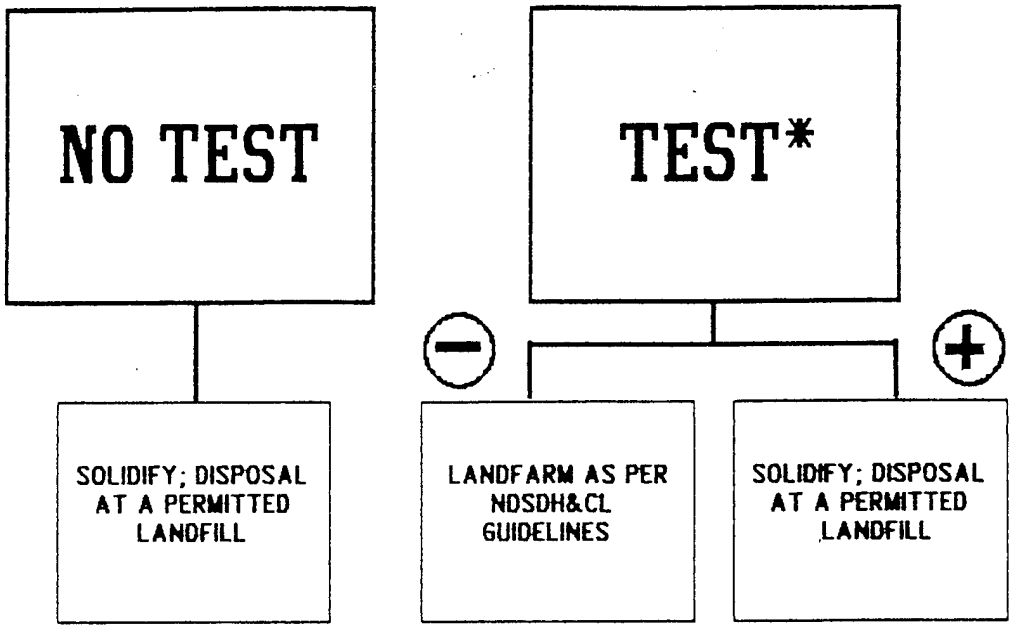
*Must prepare sample using TC Leaching Procedure.

Chart 1. Petroleum USTs/Used Oil USTs

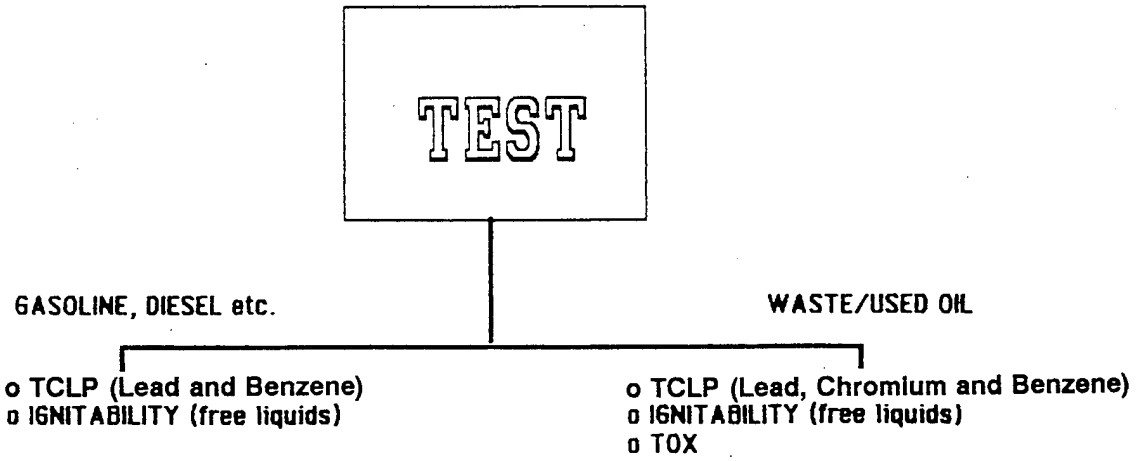
SLUDGE
SCALE
WASTE/USED OIL-CONTAMINATED SOIL
RINSATE

Containerized separately in 55-Gallon Drums (not more than 1/3 Full)

LESS THAN 220 lbs. (22 gallons)



* TEST PARAMETERS



C. If the results from this chemical testing indicates the petroleum UST waste is nonhazardous (i.e., the analytical parameters are within regulatory limits), the waste may be solidified in preparation for disposal at a State-permitted landfill or treated in a manner consistent with the Department's "Guidelines for Proper Land Treatment of Petroleum Product Contaminated Soils" (contact the Department for a copy of this guidance document). If solidified, the waste in each accumulation drum should be mixed in a 1:1 ratio with a solidifying agent such as Portland cement, fly ash or cement kiln dust. The waste in each drum should be thoroughly mixed so that the solidified waste is homogeneous. The resulting waste must have no free liquids as measured by the Paint Filter Liquids Test (SW-846 Method 9095, provided as Attachment 1 to this guidance document).

D. If the chemical testing of the petroleum UST waste indicates that the waste exhibits hazardous characteristics, the waste owner must manage the waste as a regulated hazardous waste. For requirements on the proper handling, storage and disposal of this material, the owner should contact the Division of Waste Management - Hazardous Waste Program.

E. If the <u>total</u> amount of petroleum UST waste is LESS than 220 lbs. (approximately 22 gallons - see Chart 1), the waste owner has two options for disposal or treatment of the waste. These are:

1. The waste may be solidified in preparation for disposal at a State-permitted landfill. The waste in each accumulation drum should be mixed in a 1:1 ratio with a solidifying agent such as Portland cement, fly ash or cement kiln dust. The waste in each drum should be thoroughly mixed so that the solidified waste is homogeneous. The resulting waste must have no free liquids as measured by the Paint Filter Liquids Test (SW-846 Method 9095, provided as Attachment 1 to this guidance document).

2. Samples may be taken from each waste type (sludge, scale, waste product and rinsate) and either combined into a single composite sample and analyzed or analyzed separately by the chemical testing procedure as described in Table 1. If the results from this chemical testing indicate that the petroleum UST waste is nonhazardous (i.e., the analytical parameters are within regulatory limits), the waste may be treated in a manner consistent with the Department's "Guidelines for Proper Land Treatment of Petroleum Product Contaminated Soils" (contact the Department for a copy of this guidance document). If the chemical testing of the petroleum UST waste indicates that the waste exhibits hazardous characteristics, the waste owner may solidify the waste in preparation for disposal at a State-permitted landfill as described in option 1 above.

   Permission from the owner/operator of the landfill facility is advised before any petroleum UST wastes are delivered for treatment <u>or</u> disposal.

Waste/Used Oil USTs

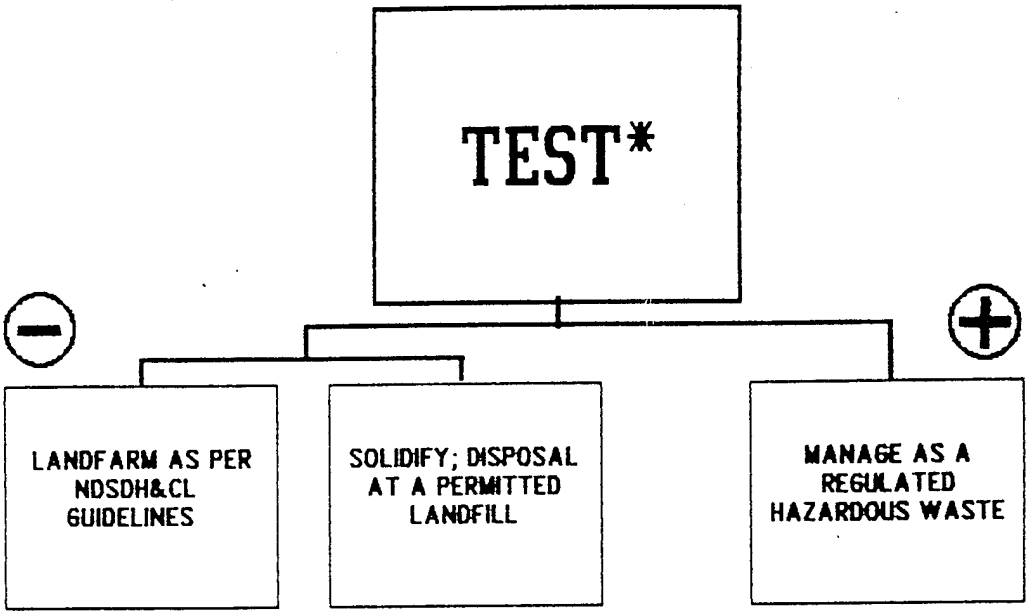
I. Recyclable used oil.

Chart 2. Petroleum USTs/Used Oil USTs

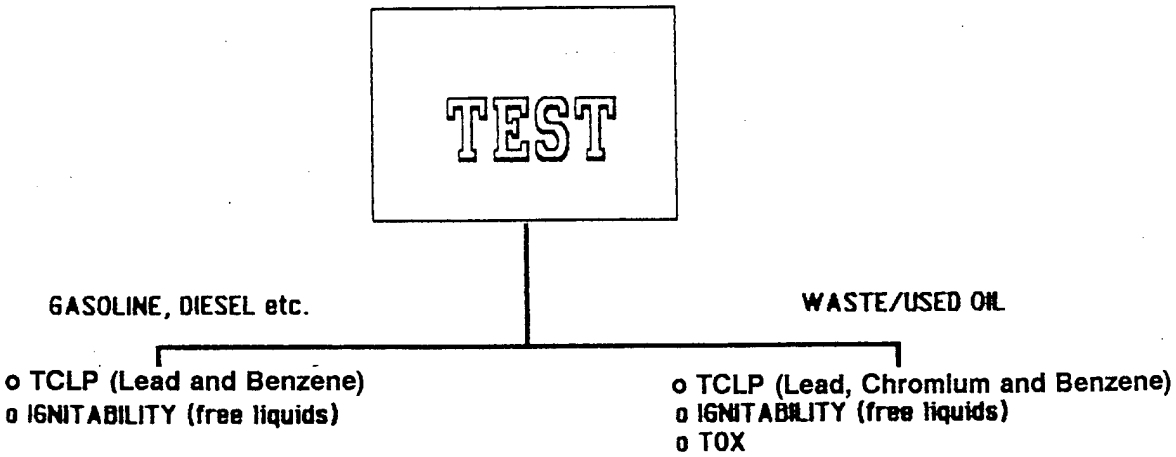
SLUDGE
SCALE
WASTE/USED OIL-CONTAMINATED SOIL
RINSATE

Containerized separately in 55-Gallon Drums (not more than 1/3 Full)

GREATER THAN 220 lbs. (22 gallons)



* TEST PARAMETERS



Recyclable waste/used oil should be delivered to a waste/used oil reclaimer for recycling (contact the Department for a list of names of waste/used oil reclaimers).

II. Waste/used oil tanks (USTs).

Waste/used oil USTs should be cleaned by the same procedure which is used for petroleum tanks, as described above in Section II. - Petroleum tanks (USTs).

III. Wastes contained in waste/used oil USTs (see Charts 1 and 2).

A. All sludge, scale, waste product and rinsate generated as a result of cleaning the inside of waste/used oil USTs must be containerized separately in 55-gallon steel drums at the cleaning site. Each drum should be filled not more than one third (1/3) full and be properly identified and/or labeled. Any rinsate from washing the tank may be discharged in the same manner as described above for petroleum tanks - Section II.D.

B. If the total amount of the waste/used oil UST waste is GREATER than 220 lbs. (approximately 22 gallons - see Chart 2), samples must be taken from each waste type (sludge, scale, waste product or rinsate) and either combined into a single composite sample and analyzed or analyzed separately by the following chemical testing procedures:

Table 2.
Waste/Used Oil USTs - Testing Procedures

Characteristic	Regulatory Limit
Benzene*	0.5 mg/l
Chromium*	5.0 mg/l
Lead*	5.0 mg/l
TOX (Total Organic Halogens)	1000.0 mg/l
Flash point (Free Liquids)	140°F

*Must prepare sample using TC Leaching procedures

C. If the results from this chemical testing indicates that the waste/used oil UST waste is nonhazardous (i.e., the analytical parameters are within regulatory limits), the waste may be solidified in preparation for disposal at a State-permitted landfill or treated in a manner consistent with the Department's "Guidelines for Proper Land Treatment of Petroleum Product Contaminated Soils" (contact the Department for a copy of this guidance document). If solidified, the waste in each accumulation drum should be mixed in a 1:1 ratio with a solidifying agent such as Portland cement, fly ash or cement kiln dust. The waste in each drum should be thoroughly mixed so that solidified waste is homogeneous. The resulting waste must have no free liquids as measured by the Paint Filter Liquids Test (SW-846 Method 9095 provided as Attachment 1 to this guidance document).

D. If the chemical testing of the waste/used oil UST waste indicates that the waste exhibits hazardous characteristics, the waste owner must manage the waste as a regulated hazardous waste. For requirements on the proper handling, storage and disposal of this material, the owner should contact the Division of Waste Management - Hazardous Waste Program.

E. If the <u>total</u> amount of the waste/used oil UST waste is LESS than 220 lbs. (approximately 22 gallons - see Chart 1), the waste owner has two options for disposal or treatment of the waste. These are:

1. The waste may be solidified in preparation for disposal at a State-permitted landfill. The waste in each accumulation drum should be mixed in a 1:1 ratio with a solidifying agent such as Portland cement, fly ash or cement kiln dust. The waste in each drum should be thoroughly mixed so that solidified waste is homogeneous. The resulting waste must have no free liquids as measured by the Paint Filter Liquids Test (SW-846 Method 9095 provided as Attachment 1 to this guidance document).

2. Samples may be taken from each waste type (sludge, scale, waste product and rinsate) and either combined into a single composite sample and analyzed or analyzed separately by the chemical testing procedure as described in Table 2. If the results from this chemical testing indicates that the waste/used oil UST waste is nonhazardous (i.e. the analytical parameters are within regulatory limits), the waste may be treated in a manner consistent with the Department's "Guidelines for Proper Land Treatment of Petroleum Product Contaminated Soils" (contact the Department for a copy of this guidance document). If the chemical testing of the waste/used oil UST waste indicates the waste exhibits hazardous characteristics, the waste owner may solidify the waste in preparation for disposal at a State-permitted landfill as described in option 1 above.

   Permission from the owner/operator of the landfill facility is advised before any waste/used oil UST wastes are delivered for treatment <u>or</u> disposal.

IV. Contaminated Soils from Waste/Used Oil USTs(see Charts 1 and 2).

A. All soil contaminated by waste/used oil should be stockpiled at the excavation site or tank cleaning site. The contaminated soils must be stockpiled in a bermed area which is lined with an impermeable material such as plastic sheeting or concrete. The stockpile of contaminated soils must be properly identified and/or labeled.

B. The stockpile of contaminated soils should be sampled and tested using the Paint Filter Liquids Test and the chemical testing procedure described in III.B of this section ("Wastes Contained in Waste/Used Oil USTs"). The same testing procedures (i.e., TC Leaching Procedures, etc.) should be used to determine if the soils are suitable for disposal at a permitted landfill. PLEASE NOTE THAT THIS CHEMICAL TESTING PROCEDURE IS REQUIRED FOR ANY VOLUME OF WASTE/USED OIL - CONTAMINATED SOIL IN EXCESS OF 220 LBS.

C. All contaminated soils which pass the chemical testing and the Paint Filter Liquids Test can be delivered to a Department approved landfill for treatment in a manner consistent with the Department's "Guidelines for Proper Land Treatment of Petroleum Product Contaminated Soils" (contact the Department for a copy of this guidance document); permission from the owner/operator of the landfill facility is advised before any contaminated soil is delivered for treatment.

D. All contaminated soils which pass the chemical testing, but fail the Paint Filter Liquids Test, must be allowed to drain until they can pass test. Alternatively, the soils may be mixed with a sufficient volume of dry, uncontaminated soil to absorb the free liquids.

1. All liquids which drained from the contaminated soils must be collected, containerized, analyzed and disposed as outlined in the Section above regarding "Wastes Contained in Waste/Used Oil USTs."

2. Once the contaminated soils pass the Paint Filter Liquids Test, they can be delivered to a Department approved landfill for treatment; permission from the owner/operator of the landfill facility is advised before any contaminated soil is delivered for treatment.

E. If the chemical testing of the waste/used oil - contaminated soil indicates that the soil exhibits hazardous characteristics, the waste owner must manage the waste as a regulated hazardous waste.

1. All soils which failed the chemical testing and which cumulatively amount to less than 220 lbs. (see Chart 1), may be mixed with an appropriate solidification agent such as Portland cement, fly ash or cement kiln dust and delivered to a Department approved landfill for disposal. The solidification agent should be mixed with the soil at a 1:1 ratio. The resulting solidified waste must pass the Paint Filter Liquids Test before it will be authorized for disposal at a permitted municipal or industrial landfill.

2. All soils which failed the chemical testing and which cumulatively amount to more than 220 lbs. (see chart 2), will need to be stored, manifested, and shipped to a hazardous waste management facility which is approved to handle RCRA wastes. In this case, the waste generator should contact the Division of Waste Management - Hazardous Waste Program for further information. NOTE: variations in the procedures outlined above must receive Departmental approval BEFORE excavation of the UST begins.

Regulatory Agency

ND State Department of Health and Consolidated Laboratories
Division of Waste Management
1200 Missouri Avenue
P. O. Box 5520
Bismarck, ND 58502-5520
(701) 221-5166

NORTH DAKOTA
STATE DEPARTMENT OF HEALTH
AND CONSOLIDATED LABORATORIES

ENVIRONMENTAL HEALTH SECTION

1200 Missouri Avenue
P.O. Box 5520
Bismarck, North Dakota 58502-5520
Fax #701-221-5200

GUIDELINES FOR THE LABORATORY ANALYSIS OF SAMPLES FROM PETROLEUM RELEASE SITES

Field screening for hydrocarbon vapors at a petroleum release site provides enough information to determine the presence of contamination and the relative concentration. In many cases, screening information may be sufficient for decision-making purposes, for example, when there is no uncertainty about the type of contaminant (i.e., the source is from a known spill or identified leaking tank). There are instances, however, when laboratory analyses may be desired during an investigation. For example, analytical data from a laboratory may be used for the following reasons:

1. To determine if a potable water supply has been affected and the need for an alternative water source;

2. To identify contaminants that cannot be detected (or differentiated) by field screening techniques; and

3. To meet state and local requirements (e.g., verification of a cleanup, site investigation activities etc.).

Given the cost and time associated with laboratory analyses, it is important that certain measures are taken to ensure accurate results. In order to avoid resampling (which results in unnecessary delays and expenses), consultants should be aware of the following common mistakes and possible solutions:

Mistakes	Solutions
Selection of inappropriate type of analysis	Consult with the laboratory and existing guidelines for recommended analyses. See Table 1 for a summary of some common analytical options.
Use of improper container and preservative	Consult with laboratory and use containers that they have approved and/or provided.
Samples unusable due to breakage or cross-contamination	Collect duplicates; place field blank in storage container with samples.
Samples unusable due to improper storage and excessive holding time	Arrange with laboratory ahead of time for analysis to be run as soon as possible after delivery; store samples in ice-filled cooler immediately following collection.
Analytical results indicate improper labeling or sample misidentification	Label samples very carefully in the field and carefully fill out chain of custody forms prior to delivery to the laboratory.

Rev. 2/12/93

Environmental Health Section and Enforcement 701-221-5150
Environmental Engineering 701-221-5188
Municipal Facilities 701-221-5210
Waste Management 701-221-5166
Water Quality 701-221-5210

I. ANALYTICAL PROCEDURES

Analytical procedures should be consistent with federal and state guidelines.

A summary of potential analytical parameters to be performed on samples taken at petroleum release sites and the corresponding methodology for each parameter are provided in Table 1; the required containers, preservation techniques, and holding times are listed in Table 2.

The following are suggested procedures for the analysis of samples (soil and water) at petroleum release sites. While the use of these procedures is not mandatory, North Dakota State Department of Health & Consolidated Laboratory (NDSDHCL) staff has the option of rejecting any analytical results which are considered incomplete, inadequate, or inaccurate. Proper sampling should include the following elements:

TABLE 1

SUMMARY OF ANALYTICAL PROCEDURES FOR GASOLINE AND DIESEL FUEL PRODUCTS

Substance to be Analyzed	Analytical Method	Instrumentation
1. Gasoline		
a. Benzene, Toluene, Ethylbenzene & Xylene (BTEX), Purgeable Aromatics	EPA 602 (water) EPA 8020 (soil)	GC GC
All Purgeables	EPA 624 (water) EPA 8240 (soil)	GC/MS GC/MS
b. Total Petroleum Hydrocarbons	EPA 418.1 * DHS	IR GC/FID
c. Purgeable Halocarbons	EPA 601 (water) EPA 8010 (soil)	GC GC
All Purgeables	EPA 624 (water) EPA 8240 (soil)	GC/MS GC/MS
d. Base/Neutrals & Acid Extractables	EPA 625 (water) EPA 8276 (soil)	GC/MS GC/MS
2. Diesel		
a. Total Petroleum Hydrocarbons	EPA 418.1 * DHS	IR GC/FID
b. Base/Neutrals & Acid Extractions	EPA 625 (water) EPA 8270 (soil)	GC/MS GC/MS
3. Oil & Grease	EPA 503	Gravimetric (Extraction)

Substance to be Analyzed	Analytical Method	Instrumentation
4. Lead--Total	EPA 239.2 Standard Methods 304	AA AA
5. Chromium	EPA 218.2	AA
6. Ignitability Flash Point	EPA 1010, 1020	AA
7. Total Organic Halogens (TOX)	EPA 9020, 9022 ASTM D808	--

* California Department of Health Services Method

TABLE 2

REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

NAME	CONTAINER	MAXIMUM PRESERVATION	HOLDING TIME
Metals:			
Chromium VI	P,G	Cool, 4°C	24 hours
Mercury	P,G	HNO_3 to pH <2	28 days
Metals, except chromium VI	P,G	HNO_3 to pH <2	6 months
Oil and grease	G	Cool, 4°C, H_2SO_4 to pH <2	28 days
Volatile Organics:			
Concentrated waste samples	8 oz. widemouth glass with Teflon liner	None	14 days
Liquid samples			
No residual chlorine present	2 40 ml vials with Teflon-lined septum caps	4 drops conc. HCl, cool, 4°C	14 days
Residual chlorine present	2 40 ml vials with Teflon-lined septum caps	Collect sample in a 4 oz. soil VOA container which contains 4 drops of 10% sodium thiosulfate. Gently mix sample and transfer to a 40 ml VOA vial that contains 4 drops conc. MCl, cool to 4°C.	14 days
Soil/sediments and sludges	4 oz. (120 ml) widemouth glass with Teflon liner	Cool, 4°C	14 days
Semiviolatile Organics			
Concentrated waste samples	8 oz. widemouth glass with Teflon liner	None	14 days
Liquid samples			
No residual chlorine present	1-gallon or 2½-gallon amber glass with Teflon liner	Cool, 4°C	Samples extracted within 7 days and extracts analyzed within 40 days
Residual chlorine present	1-gallon or 2½-gallon amber glass with Teflon liner	Add 3 ml 10% sodium thiosulfate per gallon, cool, 4°C	Samples must be extracted within 7 days and extracts analyzed within 40 days
Soil/sediments and sludges	8 oz. widemouth glass with Teflon liner	Cool, 4°C	14 days

II. INTERNAL QUALITY CONTROL CHECKS

In order to provide the necessary quality control of samples taken at petroleum release sites, duplicate samples, blind spikes, field blanks, split samples, trip blanks, and background samples should be collected and submitted to a quality assurance laboratory. The work/sample plans should state the type of sample and frequency with which a sample will be taken.

A suggested frequency for the different sample types is noted in the following table:

INTERNAL QA SAMPLING FREQUENCY

Type of Sample	Frequency	Comments
Duplicate*	10% of samples collected, if possible	Aqueous samples
Blind Spike**	When possible, in coordination with the laboratory.	
Field Blank***	One per sampling incident, if appropriate	Aqueous samples
Split Sample****	As appropriate.	
Trip Blank	Two 40-ml vials filled with deionized water/cooler.	Aqueous samples; only if samples are analyzed for organic volatiles.
Background Sample	As appropriate.	Primarily associated with onsite soil samples.

Every effort should be made to assure that representative samples are collected.

* Duplicate samples. (These are independent samples collected at the same sampling location during the same sampling event).

** Blind spike samples (samples resulting from the addition of compounds to samples).

*** Field blanks (these are obtained by running analyte-free deionized water through sample equipment after decontamination, and collecting the water in appropriate containers for analysis.

**** Split sample (the sample is divided into more than one sample container for separate analyses, usually by different laboratories.

GUIDANCE DOCUMENTS

The following guidance documentation should be used and referenced while conducting site investigations or corrective actions.

1. Groundwater Monitoring Well Design & Installation.
2. Decommissioning of Monitoring Wells and Boreholes.
3. Procedures for Headspace Analysis of Gasoline Contaminated Soils.
4. Procedures for the Collection of Soil Samples at UST Sites.
5. North Dakota Underground Storage Tank Rules.
6. Guidelines for the Disposal of Tank Sludge.
7. Guidelines for Proper Land Treatment of Petroleum Product Contaminated Soils.
8. Land Treatment of Petroleum Contaminated Soil: Single Application Sites.
9. Guidelines on Report Format for Site Investigations.

REGULATORY AGENCY

North Dakota State Department of Health &
Consolidated Laboratories
Division of Waste Management
1200 Missouri Avenue, Room 302
P.O. Box 5520
Bismarck, ND 58502-5520

APPENDIX B

PEER Consultants, P.C.

CALCULATION WORKSHEET

Project Hector Task No. ____

Originator LAM Date ____ Calc. No. ____

Checked ____ Date ____ Rev. No. ____

Subject ____ Sheet ____ of ____

Site 2

300 gal UST $300\,gal \times \frac{ft^3}{7.5\,gal} \approx 40\,ft^3$

assume 3 Ft dia $A = \pi r^2 = \pi (1.5)^2 = 7.1\,SF$

then length = 40 CF / 7.1 SF ≈ 6 Ft

assume tank = 3 Ft BGS w/ excavation 2 Ft around UST

depth: 3 + 3 + 2 = 8
width: 3 + 2 + 2 = 7 vol: 8 × 7 × 10 = 560 CF
length: 6 + 2 + 2 = 10

soil to remove = 560 − 40 = 520 CF ≈ 20 CY

Site 10

assume area $75 \times 100 \times 3 = 22500$
$70 \times 60 \times 3 = 12,600$
$35,100\,CF \approx 1300\,CY$

area assuming max depth = 4 in. = 0.33 ft

$35,100 + 520 = 35,620\,CF$

$\frac{35,620\,CF}{0.33\,Ft} \frac{acre}{43,560\,SF} \approx 2.5\,acres$

APPENDIX C

NORTH DAKOTA
STATE DEPARTMENT OF HEALTH
AND CONSOLIDATED LABORATORIES

ENVIRONMENTAL HEALTH SECTION

1200 Missouri Avenue
P.O. Box 5520
Bismarck, North Dakota 58502-5520
Fax #701-221-5200
TDD #701-224-2068

REF FILE: UST #2021

April 4, 1994

HALEY WIHONGI
HDQTRS ANGRC/CEVR
3500 FETCHET AVE
ANDREWS AFB MD 20331-6008

Dear Ms. Wihongi:

Referencing your phone call of this morning, typically, our Department has representatives present for all underground storage tank (UST) removals in North Dakota. Our Department representative screens the excavated materials for volatiles using a PID. Soils exhibiting meter readings in excess of 100 units are generally removed for treatment.

Applying these procedures to Site 2 at Hector International Airport in Fargo North Dakota, we would expect that you conduct the corrective action procedures as contained in your January 1994 plan. But if field screening of the soils, at the time of removal, would indicate that contamination in excess of 100 meter units extends beyond the two-foot limit of excavation, we would also expect that additional soil be removed back to native soils with meter readings less than 100 meter units. Likewise, if the soils show obvious staining, that soil should be removed as well.

Even though the UST Program does not directly regulate Site 10 (an UST is not involved), it would seem prudent that you follow these same procedures in addition to the corrective action procedures you have detailed in your January 1994 plan. As I explained on the phone, North Dakota has not established a cleanup level specifically for BTEX; cleanup levels are determined on a site-by-site basis. However, provided you follow the above-referenced corrective action procedures, we would consider a BTEX concentration of 40ppm as an acceptable level of soil cleanup, with a Benzene concentration not to exceed 500ppb. (.5ppm) Again, this is a site specific cleanup standard and can be changed as more information on the cleanup of Sites 2 and 10 progress.

Environmental Health Section and Enforcement 701-221-5150 | Environmental Engineering 701-221-5188 | Municipal Facilities 701-221-5210 | Waste Management 701-221-5166 | Water Quality 701-221-5210

I hope this letter answers your questions concerning the upcoming UST removal. Please give this Department advance notice of the removal in the event a representative of this office wishes to be present. Feel free to call me at (701) 221-5166 if you need additional information.

Sincerely,

Gary W. Berreth, Coordinator
Underground Storage Tank Program
Division of Waste Management

GWB:lk

TOTAL P.04